POWER

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Power Executives' Responsibility

Many industrial managers are the wonder and envy of their competitors, in the adminstration of their factories and the marketing of their products. But taken out of their own bailiwicks these outstanding factory executives frequently become as children.

Here is where the responsibility of the power chief comes in, no matter whether you call him plant engineer, chief engineer or master mechanic.

Irresponsible power chiefs are the exception, but there are some who take advantage of the boss's ignorance of power matters by making a great mystery of their jobs and in this way seeking to assure their salary checks. Such persons are enemies to industrial power production.

On the other hand, the conscientious and ambitious man with a personal interest in his job too frequently finds his plans to reduce expenses blanketed by the boss's ignorance and inability to understand what it is all about. Now why is this? If the same opportunity were offered for some beneficial change in the factory, just think how quickly it would be acted upon. This is because the boss knows his factory problems and processes from beginning to end and is at his best where they are concerned.

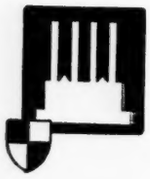
But the power plant is different. He does not understand its details. It is out of his line—a necessary evil, like fleas on a dog.

Not knowing what it is about, the boss's decision cannot be deduced from his customary mental processes. Therefore, "when in doubt, vote no" is his refuge.

The boss needs help and education in the use and money-making possibilities of power, and it is the power chief's job to see that he gets it. Examination and advice by consulting engineers should be encouraged, for frequently the consultant can speak to the factory manager in terms he can understand best and is a great aid in the battle to save the power dollar.

It is distinctly up to the power executive to meet the demand for lower production cost. It is his responsibility, and he must realize and accept it if he hopes to maintain his very livelihood.

EDITORIALS



The Grindability Of Coal

IN THE early development of pulverized-coal burning little was known of the grinding characteristics of different coals, and performance data on actual installations were eagerly sought. These, however, seldom proved reliable for the design of new plants, particularly when an untried coal was to be burned. As the use of pulverizers increased, the number of coals being pulverized increased and the performance of each new job was predicted by the equipment manufacturer on the basis of his previous experience with similar coal.

Despite the fact that certain manufacturers have now accumulated considerable data, it is practically impossible to fix a standard capacity rating for mills or to determine in advance the power requirements except for a given coal. This is because no yardstick exists with which to measure the grindability.

A valuable contribution to information on this subject and a possible clue to the establishment of such a yardstick is contained in a recent A.S.M.E. paper by R. M. Hardgrove, who described laboratory methods of measuring grindability with a given mill. Selecting a certain well-known coal as a standard, he compared the grindability of other coals with it and included a table of grindability factors for a long list of coals in the United States and Canada.

The subject is one that warrants the early attention of some body, such as the A.S.M.E. Power Test Codes Committee, in order that a standard may be properly and speedily established.

A.S.H.V.E. Research

EARLY this year the American Society of Heating and Ventilating Engineers announced the start of a new era in its research activity, and, as a preliminary step, circularized its membership for suggestions for research problems. By this means the committee hoped to ascertain the technical needs of the profession.

A summary of the replies has been issued, and, as might be expected, the proposals cover a wide variety of subjects, from heat transfer to physiology. Among the suggestions were some apparently inspired by manufacturers who would have the society perform research work helpful to them in perfecting their products. Other engineers would have the society sponsor surveys and tests comparing the performance of equipment made by different manufacturers, or develop and design new equipment.

Investigations such as these, however desirable from the individual viewpoint, can have no place in the research program of a national engineering society. It is hoped that the research committee of the A.S.H.V.E. will, in selecting projects from the suggestions received, sponsor only such work as is fundamental and will yield data of value to the greatest number of its membership.

Safety The Criterion

ELIMINATION of all speed limits for passenger elevators as provided for in the new National Code for Elevators announced by the American Standards Association heralds a new day in both the building and elevator industry. Approval of this code by the association follows three and one-half years of research at the United States Bureau of Standards on elevator safety devices. The code represents years of effort by a technical committee composed of representatives of engineering, architectural, safety, governmental, manufacturing and other interested organizations. It can therefore be accepted as the highest authority on elevator design, construction and operation.

Safety has been the criterion by which the committee has developed its various standards. If elevators are made safe to operate, then economic considerations, personal comfort and other factors will establish the other limitation. It is economical to operate elevators at car

speeds of twelve hundred feet per minute in very high buildings only. Personal discomfort due to rapidly changing altitudes may place a limit close to this speed for passenger elevators. Whatever the speed limit may be it should be allowed, provided the equipment can be made to meet high safety standards.

One of the most serious criticisms made of the elevator codes in many states and municipalities is that they place unnecessary restriction on elevator development and operation and are lax in prescribing safe practices. Speeds of modern elevators equipped with every safety device have been limited to six or seven hundred feet per minute, while permitting more hazardous conditions to exist in other ways. The new National Safety Code for Elevators is what it is supposed to be, a safety code for their design, construction and operation. Those states and cities that have not adopted it, or the equivalent, should do so. In these times of advanced safety practices there can be little excuse for state and municipal laws permitting any practices hazardous to life and limb.

Why Not Use The Mol and Pound-Mol

ENGINEERS are notoriously slow to adopt new units. Despite the much-vaunted claims for the metric system of weights and measures, American engineers have clung tenaciously to their "pounds and inches." This adherence is due not alone to conservatism, as there are economic reasons why the change of systems is not desirable in this country at the present time. On the other hand, the adherence to old systems and methods in other directions has less reason for its persistence, and, in many cases, the engineer suffers handicaps through their use. A case in point is the common habit of stating gas properties in terms of one pound instead of the mol, which has been generally adopted by chemists and chemical engineers as a measure of gas quantity. The mol is defined as that volume of gas whose weight, in the system of units in use, equals its molecular weight. In the engineers' system of units the mol would be that volume of a gas whose weight equals its molecular weight in pounds.

Since Avagadro's Law can be assumed to hold for most gas conditions with which an engineer has to deal, the volume of a mol is the same for all gases at any given temperature and pressure, as equal volumes contain equal numbers of molecules, hence are proportional in weight to their molecular weights. These facts permit the ready calculation of reactions between gases as in combustion, since only the volumes as indicated by the common chemical formulas are involved. Combustion reactions with solids and liquids may be computed in the same manner by using the pound-mol.

The mol and pound-mol are now in use in the more advanced schools of mechanical engineering and are appearing in some of the later textbooks. It is regrettable, however, that all schools do not use these units and that all authors have not adopted them. When one has had a little practice with their use and application the simplicity of the methods appeals strongly and there is no desire to go back to the older ways.

A more widespread knowledge and application of the mol will remove much of the present misunderstanding of combustion calculations and place our knowledge of this subject on a more scientific and more rational basis.

Plant Housekeeping

CLEANLINESS is a prime requisite to good operating practice, and increasing attention is being given to this feature of plant housekeeping. Boiler rooms that a few years ago were considered inherently dark and dirty places have blossomed into outstanding examples of light and cleanliness. True, many dirty ones among the older installations still exist. But in general there has been a marked change for the better. Even so, improved methods of cleaning have not been given the attention they warrant.

Rags and the broom are still the chief line of defense in many plants. Compressed air has an important place in the cleaning method of some, but this, except for special conditions, only blows the dirt from one place to another, where the old reliable broom or rag is required for its actual removal.

A vacuum-cleaning system, although it does not possess all the features desirable in a cleaning system, is closer to the ideal than any other. It will remove dust and dirt efficiently, and these are two of the chief obstacles to clean equipment. There are conditions that require the use of rags, compressed air, or some more searching treatment, but a good vacuum-cleaning system will do much to keep the use of these at a minimum. Keeping equipment clean has first place in any preventive maintenance program and makes plant housekeeping worthy of careful study.

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POWER Stands for . .

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

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EDISON BUILDING

Heated and Cooled By Electricity

Direct and indirect electric heaters and refrigerating equipment arranged for both cooling and heating are features of the new office building of the Southern California Edison Company in Los Angeles

By H. L. DOOLITTLE
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THE recently completed thirteen-story, all-electric, earthquake-proof office building of the Southern California Edison Company has a content of 3,778,000 cu.ft. and a gross floor area of 269,000 sq.ft. The steel frame was designed to resist a horizontal earthquake force equal to one-tenth the dead and live load of the structure. All earthquake bracing was electric arc-welded. The entire building is electrically heated and all offices are supplied with conditioned air.

The electrical heating system is divided into two parts, the direct heaters in the offices, and the indirect heaters adjacent to the ventilating fans. There are 739 direct heaters having a total capacity of 1,329 kw. These are installed under the windows of all offices, and range in size from 1½ to 5 kw., the majority being of 1½ kw. capacity. These heaters operate at low temperatures (so-called black heat), so there is no discomfort to a person working close to them. Each direct heater is provided with a single-pole thermostat that controls the heater current direct, permitting the occupant of the room to regulate the temperature to suit his needs.

Circuits are so arranged that the heaters on each floor are divided into four groups. This permits a portion of a floor to be used without having to heat the entire floor. All direct heaters operate at 115 volts, and are supplied by a 115/230-volt, 3-phase, 4-wire system.

The indirect heaters are made up of banks of 3.8-kw., 110-volt ribbon-type units, connected three in series on 440-volt, 3-phase service, thus giving a little over 20 kw. per set of three. The total capacity of all indirect heaters is 1,589 kw., distributed as follows: 611 kw. in the tower, 856 kw. in the basement and 125 kw. in the auditorium. Temperature is controlled by thermostatic operation of the heater banks in six steps set one-half degree apart. The main circuit breaker on each heater bank is interlocked with the fan control so the heater cannot be energized unless the fan is operating. A temperature trip is provided to deenergize the heaters in case the air temperature becomes excessive.

Current to the direct heaters is supplied by a bus consisting of 3-in. extra-heavy iron-pipe-size copper tubing running from the main switchboard to the top floor. This tubing is mounted on porcelain insulators and inclosed by a housing of transite. On each floor distributing panels provide for circuits from the main bus to the heaters.

On account of the large size of the building the ventilating system was divided into three parts: the basement system serves the first six floors, the tower system provides for the remainder of the building excepting the auditorium, which has its own system. The combined capacity of the three systems is 193,000 c.f.m., which is equivalent to six changes of air per hour.

All fans are driven by variable-speed motors with cog-belt drive. The air is passed through multi-panel air filters and treated for the removal of odors. Water supplied the washers is automatically maintained at the proper temperature for humidity control. The air washers and heaters are bypassed with automatically operated dampers. The air washers and cooling equipment are proportioned to maintain a building temperature 15 to 20 deg. below the outside temperature, which has been found to be the maximum practical difference for this climate.

The general arrangement of the ventilating system is shown in the diagram. Reheating after dehumidifying is accomplished by bypassing the required amount of return air around the air washer. This results in a saving in operating cost, as the reheating would otherwise have to be done electrically. The amount of air bypassed, and therefore the temperature of the air supplied, is regulated by damper *4*, which is operated by a dry-bulb thermometer in the return-air duct. The return air is fairly representative of the conditions in the building, so regulation is made at that point.

The amount of return air wasted is determined by the positions of dampers *2* and *3*, and the amount of fresh air entering the system by damper *1*. These three dampers are automatically regulated by a wet-bulb thermometer in the fresh-air duct. When the outside wet-bulb falls below that maintained in the building dampers *1* and *2* open and damper *3* closes, thereby increasing the amount of outside air taken into the system. This results in a reduction in the refrigeration load, as the lower the wet-bulb the less excess moisture there is to be removed from the air. A minimum of about 25 per cent of fresh air is supplied at all times to make up for the air lost through leakage and the lavatory exhaust system. All lavatories and some of the rooms in the medical department are connected to a separate exhaust system discharging to the outside, although these rooms are supplied from the main system.

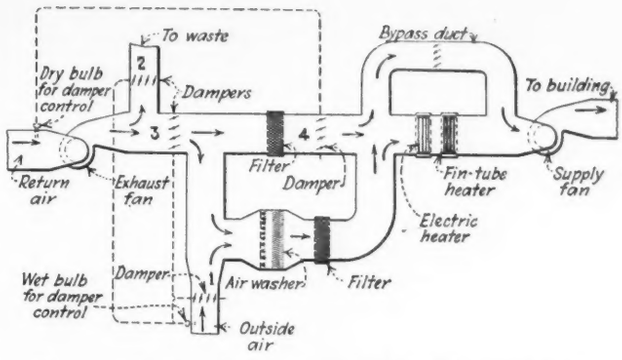
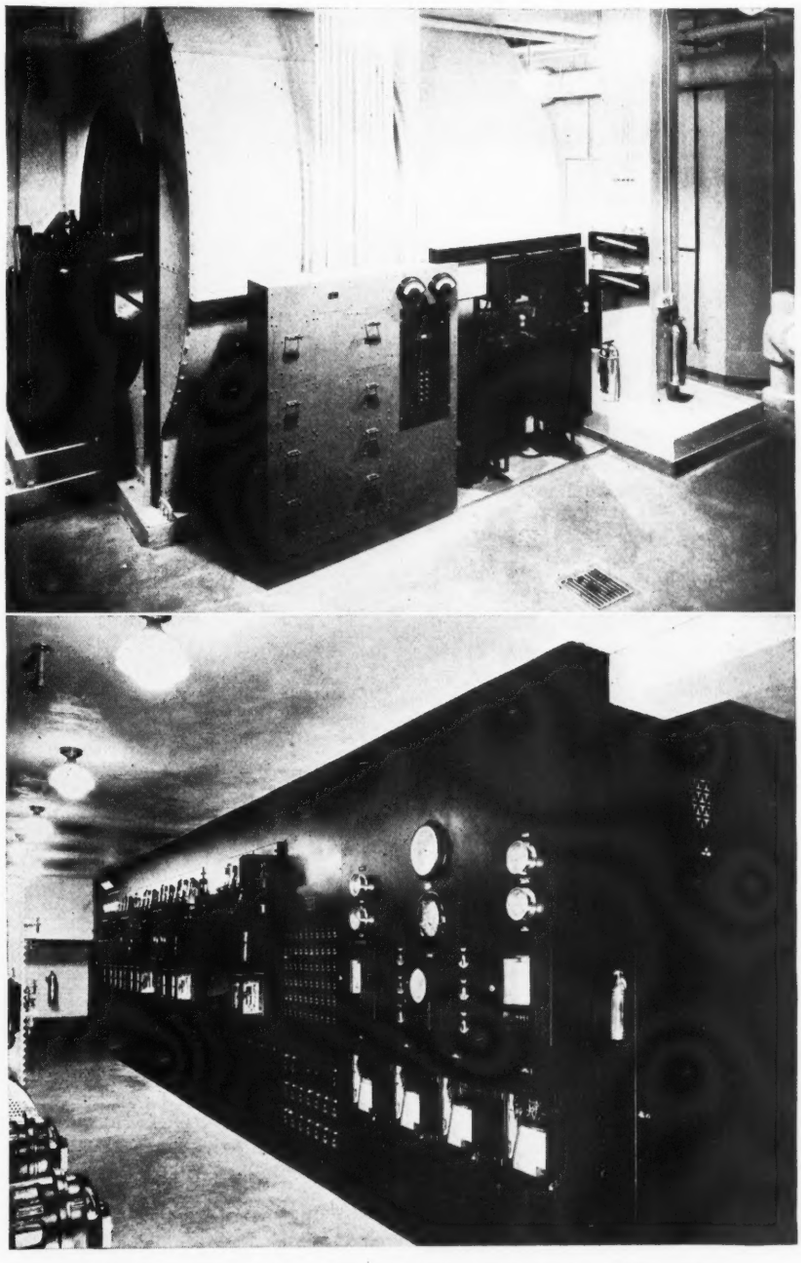


Diagram showing air flow through conditioning equipment

The duct system is so arranged that air can be supplied through a register near the ceiling and exhausted at the floor line, or the reverse if desired. It has been found most satisfactory, however, to supply both heated and

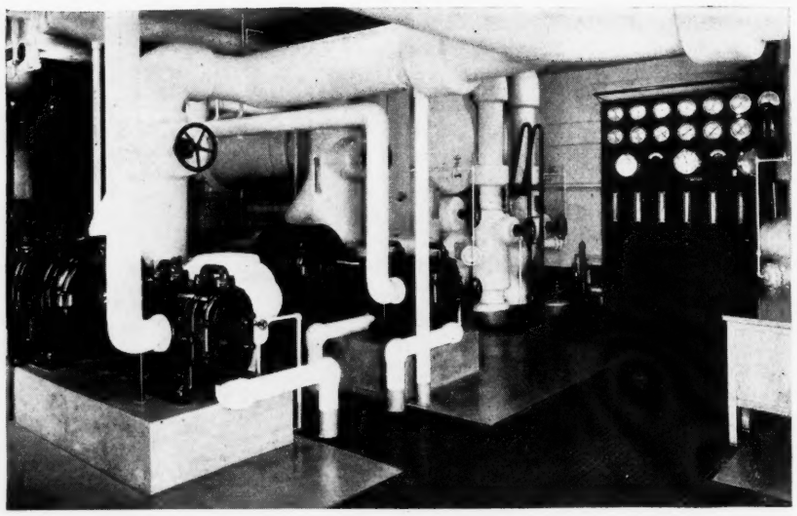


Above, basement exhaust fan and control equipment. Below, main switchboard showing recording instruments that have been provided

cooled air at the ceiling, as this results in a minimum of drafts. For the proper operation of the system all windows must be kept closed.

When water is recirculated in an air washer both the water and the discharged air attain practically the wet-bulb temperature of the entering air; also, the air discharged is practically saturated, that is, it has 100 per cent relative humidity. Treating air in this simple manner will result in a fairly satisfactory low temperature, but the high humidity is undesirable. This high humidity can be reduced only by refrigeration, and the most common method is to cool the water supplied to the air washer. If this water is cooled so that the air discharged is at the dew point corresponding to the humidity desired at room temperature, then the air leaving the washer will contain the proper amount of moisture to give the desired humidity after being reheated to the temperature of the room. If it is desired to maintain a dry-bulb room temperature of 72 deg. with a relative humidity of 50 per cent, the air leaving the washer will have to be cooled to 52 deg., as that is the dew point corresponding to the room conditions. Saturated air at 52 deg. contains the same amount of moisture, 58 gr. per pound, as 72-deg. air having 50 per cent relative humidity.

To condition the 193,000 c.f.m. of air supplied to the building 480 tons of refrigeration is required. The equipment consists of four 120-ton duplex rotary compressors directly connected to 200-hp. synchronous motors operating at 1,000 r.p.m. The refrigerant is methyl chloride (CH_3CL) and the normal conditions for cooling are 25 lb. pressure, 36 deg. F. suction and a head pressure of 85 lb. gage and temperature of 180 deg. F. Each 120-ton compressor under these conditions will require not over 155 hp. While this power consumption is probably one-fourth more than would be required with ammonia, it was decided that the lower operating pressure, the rotary compressor and the absence of ammonia in the building offset this one disadvantage.

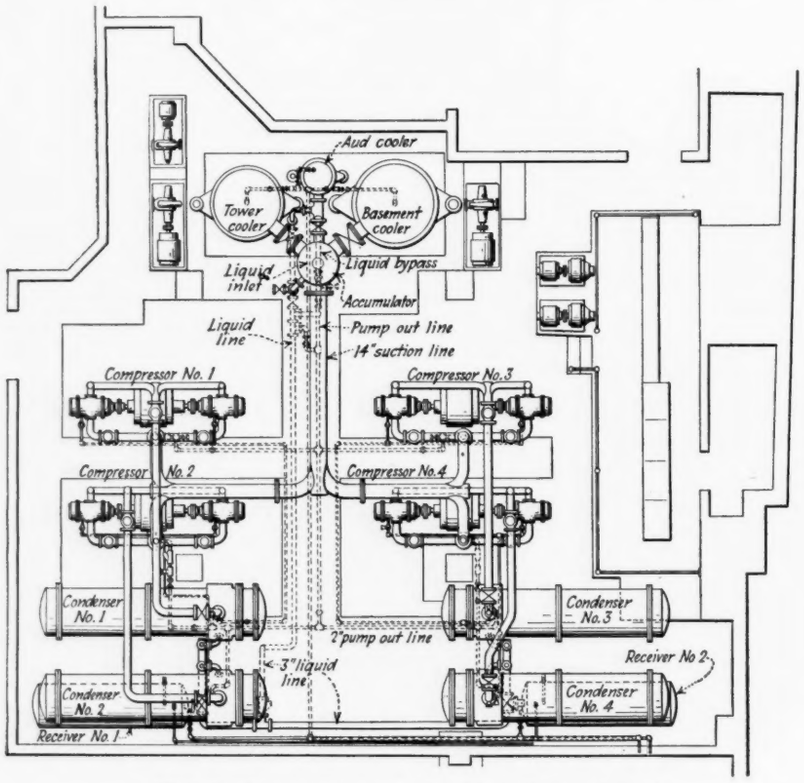


In back of the two methyl-chloride compressors may be seen one of the condensers and gage board

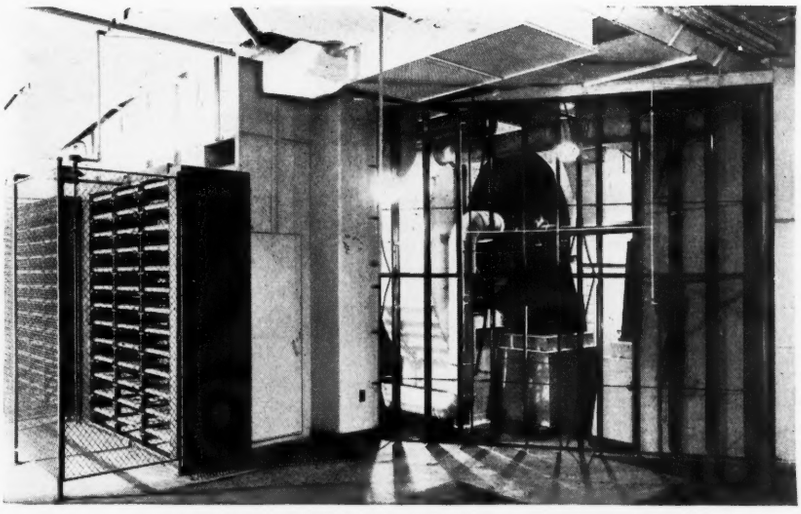
Each compressor consists of a pair of herringbone gears rotating with small clearances in a casing. The ball bearings are lubricated and the clearance spaces are sealed with glycerine, which is pumped through the compressor with the refrigerant, separated out in the condenser and re-used indefinitely.

There are four two-pass condensers, each having a surface of 2,790 sq.ft. Condensing water is supplied by two 40-hp., 900-g.p.m. pumps, which force the water to two special air washers on the roof used as cooling towers. Each washer is equipped with a 130,000-c.f.m., 50-hp. fan. To produce the maximum cooling effect the air washers are equipped with a duplicate set of nozzles, and the water is passed through the two sets in series. A separate pump is installed to force the water through the second set of nozzles.

The air washers for the basement, tower and auditorium systems are installed on different levels; so it was necessary to use a separate cooler for each system, as the cooled water could not be distributed satisfactorily at three different pressures from a single source. Specially designed vertical-tube coolers were used, all coolers being of the same height and set at the same elevation. This arrangement permits the coolers to be supplied with refrigerant from a common source. The liquid refrigerant passes from the liquid receiver under the condensers through an expansion valve into a vertical accumulator. From the bottom of this accumulator the liquid flows to each cooler. The



Plan showing arrangement of refrigerating equipment



The electric heaters at the left heat the air supplied to the fan seen through the open bypass dampers

gas from the tops of the coolers is piped to the top of the accumulator, and at this point the suction line to the compressors also is connected. A separate pump for each cooler circulates water through the cooler to the air washer. The water temperature is controlled by a thermostatically operated valve bypassing the water around the cooler.

The refrigerating compressors are controlled by a thermometer inserted in the central tube of the basement cooler. The controller cuts the four compressors in or out as the load requires, and maintains the liquid temperature with a variation of only one degree. It also energizes control circuits which start up the synchronous motor exciters, cooling-tower pumps, fans, etc., in the sequence required for the number of compressors operating.

One of the interesting features of the system is the provision being made to experiment with the use of refrigeration equipment for heating.[1] While not a new idea, this is probably the first time it is being tried on a large scale.

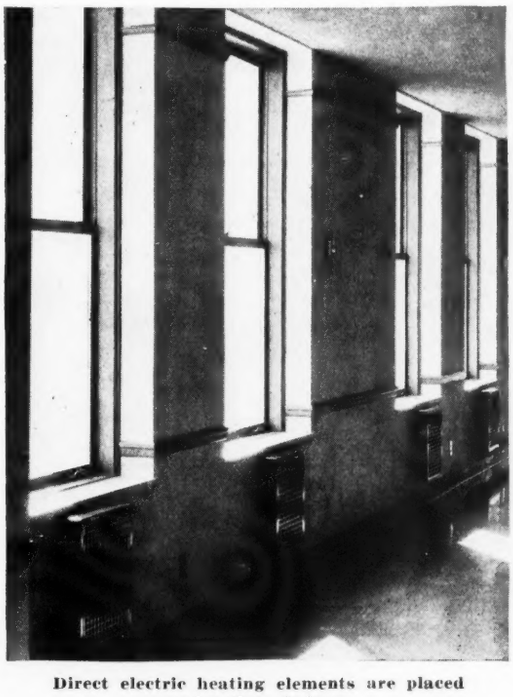
In the tower system a fin-tube heater has been installed through which the condenser water will be circulated in winter. To heat the air supplied to the building to 80 deg. a water inlet temperature to the heater of 92 deg. will be required, making it necessary to raise the head presure on the compressor to 92 lb. This condenser water temperature of 92 deg. will be maintained by a regulating valve in the water supply to the condenser operated from the pressure in the discharge of the compressors. A rise in pressure will increase the amount of water to the condenser and a drop in pressure will decrease the water. Operating at this higher head pressure, 600 hp. will be required to drive three compressors and 60,000 B.t.u. per minute will be available for heating the air supplied to the building.

Heat will be absorbed for winter heating from the atmosphere, accomplished by circulating water from the coolers through the cooling towers on the roof. To absorb heat from the air in this manner the water must be below the wet-bulb temperature. It was not considered desirable to use brine in the coolers for the heating period, so this fixed the lowest safe temperature for the cooler water at 35 deg. Allowing a 5-deg. rise in the cooling tower and a terminal temperature difference between air and water of 2 deg., a minimum wet-bulb temperature, 42 deg., was obtained below which the refrigeration heating system will not operate. This imposes no serious limitation, however, as the Weather Bureau records show that the wet-bulb in Los Angeles rarely drops lower.

The fin-tube heater and some extra piping was all the additional equipment installed for the heating system; all other equipment was needed for the regular refrigerating system. The refrigerating heating system has not yet been operated, but it is expected that it will absorb from the air and discharge into the building two to three times the heat equivalent of the power required to operate the compressors, pumps and cooling-tower fans.

Complete equipment for indicating and recording all data has been installed. All important temperatures are recorded on multiple recorders. There are recorders for fan speeds; and all power to the different parts of the heating, refrigeration and ventilating systems is metered separately. Everything has been done to obtain accurate and reliable data on the performance and operating costs of the entire installation. After a year's operation some interesting and valuable facts should be available.

The duct system was installed by Haverty Company of Los Angeles, the ventilating and air-conditioning equipment by the Cooling & Air Conditioning Corporation of New York, and Hunter & Hudson of San Francisco were the engineers.



Direct electric heating elements are placed under the windows

[1] See *Power*, June 16, 1931, page 948.

Welding an Ice-Freezing Tank Without Distortion

Practical pointers on the arc-welding of freezing tanks and other large areas with a minimum of distortion and that where least harmful

BY I. E. SCOTT
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IT HAS BEEN but a very few years since the building of an ice-freezing tank represented a tremendous outlay of work, and the driving of thousands of rivets, together with the necessity of calking. But, from all appearances of these early tanks, their builders were troubled very little with distortion or buckling, a major problem with the welded tank of today

In the building of such a tank by electric welding I have found methods that can be used to minimize the stress set up in the welded seams, which, in turn, is responsible for distortion or so-called buckling. First it will be necessary to take into consideration the general characteristics of electric welding.

Essentials of Good Welds

In order that a tank seam may have ample strength to be safely depended upon, a good weld having a cross-section at least equal to the thickness of the plate being welded, and with a thorough penetration, must be produced. Such welds having a tensile strength of from 35,000 to 50,000 lb. per square inch may be produced by any good welder.

The arc is formed by current flowing across a gap between the electrode or metal rod and the work plate. A small amount of the material forming the terminals of the arc gap is heated to an incandescent vapor. This vapor provides the material in the arc stream by which the current passes from one terminal to the other.

Speed, Gap, Current Must Be Controlled

In running a good weld bead it is necessary to travel at the proper rate of speed, and an arc gap of correct length must be maintained. The speed and arc length are governed by the welding current being used, the size of electrode and the thickness of the material being welded. A heavy body, being able to conduct heat away from the weld at a much greater rate than a light metal, necessarily takes a correspondingly heavier current.

A properly trained operator can tell at all times the condition of the weld being made and whether he is maintaining the proper arc length. Slag, oxides, etc., may be distinguished floating on the molten metal, either as light or dark spots, depending on the melting point of the impurity.

Direct current is generally used for arc-welding, and the work plate is made the positive terminal. This is because the most heat is liberated at the positive terminal and the conduction of heat in the plate will be partly compensated for by the liberation of this additional heat. It is plain, from this point of view, why alternating current is not desirable for welding. The arc flame is in constant motion and irregular shapes are very easily deflected by drafts, vapor, or magnetic fields.

When welding in corners or by the side of a baffle or other particular angles, the electrode position often has to be shifted to change the relation of the arc flow to the cross or adjacent magnetic fields.

In the construction of very small tanks, steel barrels, etc., a continuous weld may be made, contraction being allowed for by the gap in the sheet being welded. Jigs are generally used on such work. It is a very different story, however, when the welding of an ice tank is to be performed.

Welding Large Tanks

Here we have many square feet of surface to be worked over, and such a thing as a jig is out of the question. The number of feet of seam to be welded runs into thousands in many tanks, so it is plain that a welding method must be chosen which will produce the best finished product. That means a job with a minimum of buckling and one that dose not require too much additional time.

In my first experience in building a tank I used a plate with one end rolled up to the desired height of the tank wall. These plates were all placed in their proper positions and spot-welded every two or three feet. Welding was begun in the center of the tank and the seams welded toward the sides, using the step-back method. (I might say right here that the step-back method is the only possible way that I can see by which any tank seam can be welded with a minimum of stress.)

Wavy Walls Because Welding Started at Center

This produced a nice flat bottom, but when I came to the tank sides I found that one or the other side of the sheet had drawn to some extent and in turn caused a wavy or zig-zag appearing side that was very hard to

fit a tank frame into. These sheets had been badly distorted in shipment, which was probably the cause of part of my trouble.

My next experience was in building a tank using sheet with a four-inch turn on one end, with the idea of welding a long sheet of the desired width to this turned-up angle to form the tank sides. This I still believe to be the proper form of sheet, as the small turned-up ends can be peened, if necessary, to fit up to the side sheet preparatory to welding. This tank was fabricated by spot-welding as was the prevoius one, and the whole bottom was step-back-welded before making the final side, or perimeter, weld.

Again, I had a good flat bottom before making the perimeter weld. However, after the sides had been welded in place several raised or buckled places were apparent in the tank bottom, showing that it had been "pinched" by the contraction of the whole perimeter. It was plain that the contraction of this weld was very similar to the shrinking on of a wheel tire—the tank bottom got what the spokes of the wheel would be expected to get.

Working In From the Outside

From this experience, I decided to reverse my procedure, and so far I am well pleased with results obtained.

My present procedure, using the sheet with a small turned-up edge to which the side plates are welded, is to fabricate the tank by light tack-welding.

The tacking in the tank bottom is light enough so that any strains set up in these sheets easily break the tacks, allowing the sheet to release the strain set up in it.

My first welding includes the entire perimeter weld at the base of the tank sides. The tank seams are then completed. In welding the bottom all seams are begun at the edges and welded toward the center of the tank, using about a 10-in. step-back and carrying all seams from one side to the center, at about the same rate. In other words, I do not weld clear to the center from the side on one seam before beginning another. Rather, I weld out, say four or five feet on each seam, and repeat until the center is reached.

In so doing the ends of the sheet are free to travel. I have seen some of them finally welded an inch from where they were originally tacked. I have turned out some very good tanks by this method, and the sides were as straight as could be desired. Any one who assembles tank frames can appreciate a good square-sided tank to work from.

An angle iron is used in the bottom at the end of the tank, because a rolled edge is not possible in the long lengths of the outside bottom plate. The outside bottom sheet is welded across before the angle iron is welded in at all. After this end bottom sheet is welded across the end bottom angle is tacked in place, as are all the side sheets. The entire side weld is then made from tack to tack before the bottom of the end angle is welded to the tank bottom. Now the whole tank bottom, which was very lightly and sparsely tacked, is ready to be welded.

The top angle iron on which the tank frame rests need not be attached by a continuous weld, as the cans are very buoyant and support the tank frame when the tank is in operation. A two-inch tack every foot is ample.

While it is probable that some distortion will show up, even in the best designed tank-building procedure, it is usually evident that such distortion will appear in the vicinity of the final welding. Therefore I would recommend that such vicinities should be noted in advance; never allow the final welding to be at a particular baffle or agitator compartment, where a slight distortion would be very objectionable.

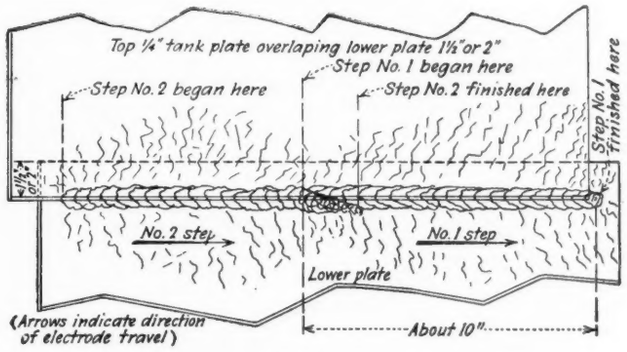
General Tips

The amount of current used should not exceed that actually required to make a good weld at a moderate rate of speed, say six or eight feet per hour on $\frac{1}{4}$ in. plate. The use of excess current, in order to hurry the job along, invariably results in undue distortion.

It is my contention that a tank can be built in place with better results than can be obtained by holding it on horses.

There are several things against building a tank up in the air, and only one reason that I can see for doing so. That is for the purpose of testing for leaks. Even this is unnecessary, as careful welding, and careful inspection before painting, will reveal anything of faulty nature, while the usual painting would stop any minute leaks.

I might mention that in our work on quarter-inch steel, making lap welds, I find that a pound of $\frac{3}{16}$-in. electrode makes about $3\frac{1}{4}$ ft. weld. I also find that one kilowatt-hour of electricity will produce $1\frac{1}{2}$ ft. of seam weld.

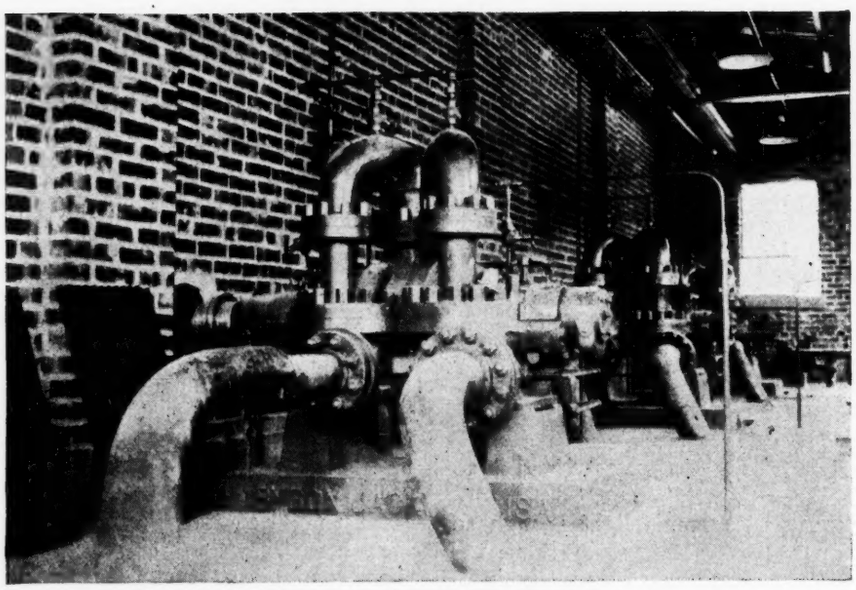

Top ¼" tank plate overlaping lower plate 1⅛" or 2"
Step No. 1 began here
Step No. 2 began here
Step No. 2 finished here
Step No. 1 finished here
No. 2 step
No. 1 step
Lower plate
(Arrows indicate direction of electrode travel)
About 10"

STEP-BACK METHOD OF WELDING

Small lines indicate scale cracks which develop while the welding proceeds, and clearly indicate the location and amount of stresses. These stresses are greatly reduced by set-back welding.

Pipe Line Engines Burn Butane

By G. L. LINDSAY*



Four centrifugal pumps handling gasoline. These are separated from the engines by a fire wall

Vinegar and water will not mix, so the old saying goes. Engineers of the Phillips Pipe Line Company found that gasoline and butane were equally unfriendly, so the butane used as fuel for the pumping engines is forced through the same pipe that conveys gasoline from Texas to St. Louis, Mo., over 700 miles

ONE OF the most startling innovations in the petroleum industry in recent years was the decision of the Phillips Pipe Line Company to abandon the hauling of gasoline in railroad tank cars and to pump the fluid through pipe lines. This 8-in. pipe line, running from Borger, Tex., to St. Louis, Mo., has been accorded considerable publicity on account of its progressive engineering features, chief of which is the combination of high-speed centrifugal pumps driven by slower speed engines using butane as fuel.

Surprisingly, the butane used by the engines is pumped through the pipe carrying the gasoline. It happens that the butane and gasoline do not mix readily unless agitated. The butane is pumped into the line, forcing the gasoline ahead of it, and at the various stations is tapped off to storage tanks. The arrival of the butane at a station is ascertained through the changes in the hydrometer reading of the fluid in the line.

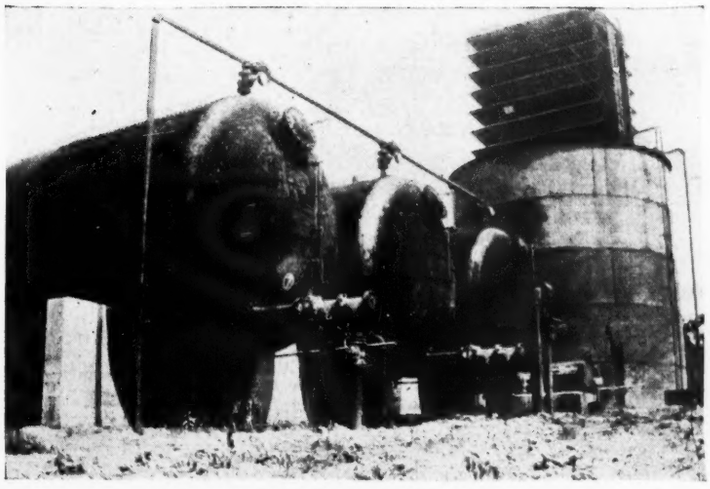
*Chicago Pneumatic Tool Company.

To understand the construction and operation of these gas engines, a few words must be given to a description of the fuel. Contrary to what appears to be a fairly common belief, butane in its natural state is not a liquid, but a gas, and is compressed and thereby converted to a liquid merely to obtain a more convenient form for shipping, handling and storing. To permit its use in a gas engine it is only necessary to reduce the pressure under which it is retained and supply the required latent heat of vaporization. The engine itself is capable of burning either natural gas or butane with some change in design, although additional accessories are necessary to secure the vaporization of the butane before it passes through the valve which serves to meter the gas and air and to distribute the proper mixture to the cylinders.

It is needless to mention the source of butane, since it is generally known to be a constituent of natural gas, as well as a product of cracking plants, but to those not acquainted with the chemical and physical properties of butane a brief description may be helpful in comprehending its behavior as an engine fuel. The name butane here applies to the commercial grade in which the paraffin hydrocarbon having a molecular formula C_4H_{10} predominates, together with small fractions of propane and pentane. It has a heat content of 102,400 B.t.u. per gallon, or 3,200 B.t.u. per cubic foot of gas; and each gallon of liquid is equivalent to 32 cu.ft. The vapor pressure at 70 deg. F. is 33 lb. per square inch gage, and is zero at 15 deg. F. Consequently, the pressures to be dealt with are low and dependent upon the temperatures of the liquid. The latent heat of vaporization, which must be supplied to the liquid in order to gasify it, is

830 B.t.u. per gallon, and may be secured from the engine cooling water.

When the possibilities of butane as an engine fuel were first brought to the attention of the Chicago Pneumatic Tool Company, which supplied the engines for the 700-mile pipe line, some samples were obtained from the Philfuels Company at Detroit and a test conducted on a 120-hp. gas engine. Data on engine operation with butane were supplemented by plant experiments on the actual engines purchased by the Phillips Pipe Line Company. These machines were similar in design to the 120-hp. unit first tested, but had six cylinders, $10\frac{3}{4}$-in. bore and $13\frac{3}{4}$-in. stroke, and had a rating of 265 hp. at 360 r.p.m.



Butane tanks at pumping station

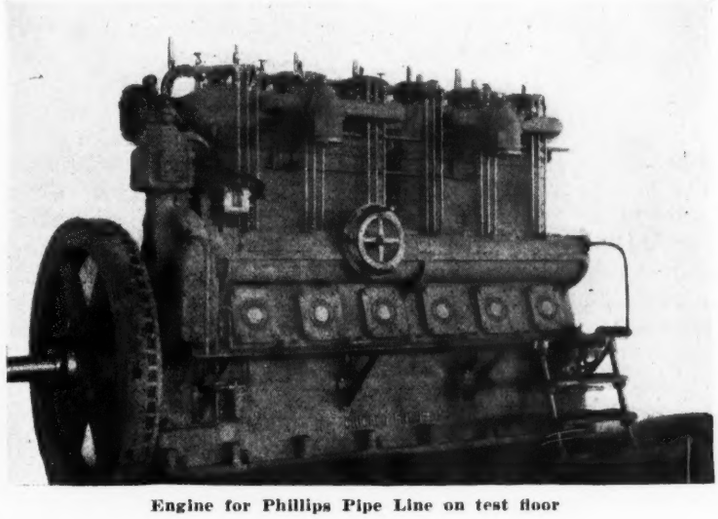
Although for test purposes the butane vaporizer required a number of manometers, pressure gages, thermometers, pressure regulator, gasometer and meters, the equipment used in a permanent installation is simple and entirely automatic in operation. It is only necessary to apply the latent heat of vaporization in an amount dependent upon the atmospheric temperature and to reduce the pressure to that used at the engine. The vaporizer should be located conveniently close to the engine to avoid the larger size of pipe which the gas demands, and to lessen probability of condensation. Moreover, the gas lines must be protected if there is danger of the temperatures dropping below the dew point, 26 deg. at atmospheric pressure.

The advantages of piping the liquid instead of the gas will be readily understood when it is pointed out that the ratio of liquid to gas by volume is 1 to 240. At this point it may be stated that butane can be mixed with air to obtain any desired B.t.u. content before it is used. Automatic devices are on the market for such a purpose, and are utilized primarily by gas companies supplying small communities for home or industrial consumption to supplement the manufactured gas on peak demands or for other reasons. Preliminary carburetion of this nature may be required for certain kinds of burners, and in that case the mixed gas can be used as power fuel if more convenient than the pure butane.

The engines in the Phillips Pipe Line stations have several interesting features. Despite the fact that an operator is always on duty, complete protection is afforded by automatic engine stops which shut down the engines if anything detrimental occurs. The manufacturer has equipped the machines with an overspeed stop which is readily adjustable to any speed, quickly reset, and positive in action. A cooling water temperature stop is set for a maximum temperature of the exhaust jacket water. Likewise, a lubricating oil pressure stop is adjusted for the minimum pressure desired. To make the latter completely automatic, it is cut out when the control wheel is in any position other than "running." All the stops are connected in parallel to the magneto, which is thereby grounded to the engine frame when any of the protective devices operate. Shutdown is permanent until the operator remedies the trouble and again starts the engine. In conjunction with these, the customer has added an appliance which stops the units in the event of an excessive pressure in the pipe line. This is virtually an over load stop, since the load is a function of the pump discharge pressure.

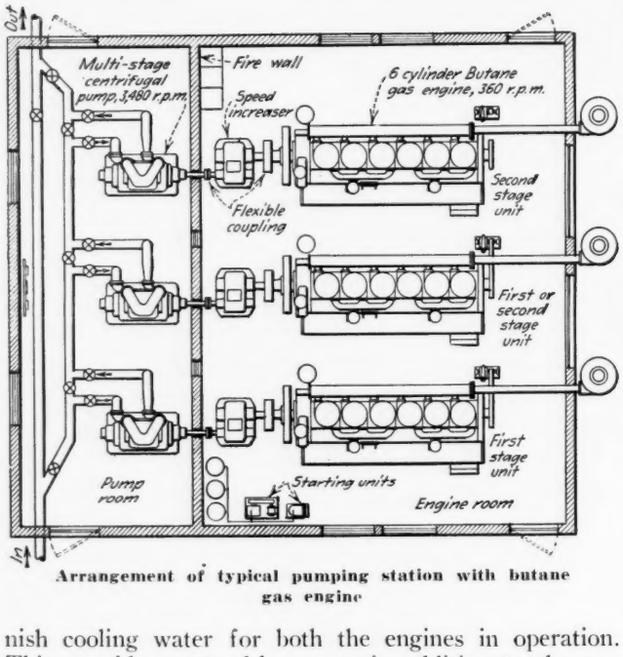
Conversion of the engines into solid-injection diesels with a minimum of effort is obtained by changing the cylinder heads to provide reduced compression space and replacing the magneto by fuel-injection pumps. All the other major parts are the same, since diesel design is incorporated into the gas engines, thus making them desirable units for pipe line service. The changeover in fuel from butane to natural gas requires only a few minutes; from gas to oil a few hours. As a matter of fact, the engines at Borger, Texas, are using natural gas, which is plentiful there, while the others use butane. Moreover, natural-gas engines in Texas oil fields have already been converted into diesels, all of which serves to illustrate the adaptability of this type of prime mover to several fuels.

High-speed centrifugal pumps are rather an innovation in pipe line service when driven by a relatively slow speed engine. To reach the pump speed of 3,480 r.p.m. step-up gears are interposed between the engine and pump. These have a ratio of approximately 9.66, and connect to engine and pump by flexible couplings.



Engine for Phillips Pipe Line on test floor

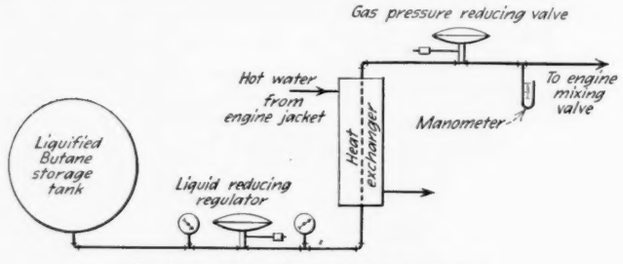
Most of the stations have three units, one acting as a reserve, while two are in continuous use. These two units have their Multiplex Byron - Jackson gasoline pumps connected in series, producing a line pressure of 750 lb. per square inch. The pumps are separated from the engines by a fire wall to eliminate fire risks in case of a pipe leak. Each machine has a belt-driven centrifugal water pump of sufficient size to fur-



Arrangement of typical pumping station with butane gas engine

nish cooling water for both the engines in operation. This provides a stand-by pump in addition to the one not in use on the reserve engine. A cooling tower and tank take care of the jacket water for both engines and the water-cooled speed increasers.

Air-gas ratios being 29 and 31 give the best efficiency, with an hourly gas consumption of 3.1 cu.ft. per horsepower-hour. The other pipe line output will be 19,500 bbl. per day, and the total fuel consumption of the four-



Fuel vaporizer for butane gas engines

teen engines will approximate 172 bbl. daily. On this basis it is estimated that the fuel cost per barrel of gasoline pumped one mile will not exceed $0.00126.

When the line has been in service for an appreciable period of time and actual operating costs made available a comparison with other types of pipe line equipment will prove both interesting and beneficial to the industries concerned. Then conclusions can be drawn concerning centrifugal vs. reciprocating pumps and butane gas engines vs. diesel engines or electric power.

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OXYGEN, besides being used for welding and cutting, can also be used for testing work for leaks or other defects when there is no water or air pressure available for this purpose. Hose suitable for the pressure desired should be fitted with connections so that one end can be attached to the oxygen regulator, and the other end should have a tire air-filling valve. A large-tube valve stem should be cut off next to the flanged end and a $\frac{1}{4}$-in. pipe thread cut on it. This can then be fitted onto the work to be tested. If it is desired to save gas, fill with water or use a hand tire pump first; then the final pressure can be had from the gas tank by setting the regulator at the pressure needed.

Scheduling Maintenance Work For Reliable Operation

By MARIN PHILLIPS

IN THE "good old days" plant machinery and equipment were kept in operation by a repair department which functioned when called upon by the department heads. Today this method has been replaced by a well-planned maintenance program executed by a corps of trained mechanics. An effective maintenance program includes personnel training, inspection and repairs. The cost of repairs and continuity of production depend on how well the first two items are taken care of. The maintenance schedule described herein has been effective in keeping in good operating condition 10,000 hp. of 440-volt, 3-phase motors ranging from 2 to 250 horsepower.

The biggest factor in personnel training is conveying to workmen the duties expected of them. It is impossible to put a workman on a job and tell him all that is required to complete the work in a prescribed manner. Even if this could be done, he could not remember it. The best policy is to put all instructions in writing. This will educate the workmen and make them more valuable. On the other hand, if they are unsuited to the work it will be found out sooner if they do not have the excuse of not knowing what was expected. Written instructions go for a thorough job, and this increases reliability and reduces costs.

When installing motors, if the pulley is not properly located it will overlap the motor bearing and is likely to injure the attendant's hands when he is inspecting the bearing. When the motor leads are allowed to be on the same side of the machine as the belt-adjusting screw they interfere with using a wrench on the screw and as a result the insulation on the wires may be injured. By installing the oil well gages on the opposite side of the bearing from the belt's pull the attendant is kept away from close contact with the belt. Written instructions as to how these and other parts of the work is to be done should be given to the workmen.

OPENING A SAFETY SWITCH UNDER LOAD

Sometimes it becomes necessary to pull a safety switch under load. If the arc barriers are not in place the arc may spread to opposite phases, causing a short-circuit that will shut down other equipment and possibly seriously injure the workman opening the switch. Insulated stools or low platforms should be installed in front of 440-volt starter racks as a safety feature when making repairs, tests, etc.

It is common practice with electricians to leave motor terminals untaped until the rotor's direction of rotation is tested. In one case an electrician started a motor with the leads untaped, then walked over to see the direction in which the rotor was turning. He slipped and touched the bare terminals and was electrocuted. This could have been avoided by making it a practice to tape the connections before starting the motors.

Operating and maintenance instructions are of further value in breaking in new workmen, as they can read them and grasp their new duties more quickly.

Routine inspection is the foundation of the maintenance department. To make it of the highest value, records of the inspections must be tabulated. The inspec-

tion record system, however, must be simple and easily operated, or an added expense will be incurred.

After a careful study of ways of keeping track of inspection in one plant the electrical equipment was divided into departments, rooms, etc., so that the inspection periods would come around every five weeks. This schedule has worked out very well and has resulted in the elimination of practically all avoidable delays. Where no record of inspections is kept there will be a certain amount of out-of-the-way equipment that will be neglected.

When the inspection of a department is started it is completed. This makes it easy to check off the work and insures that none is forgotten. The inspection chart hangs on the wall in the electrical shop and the equipment is checked off as the inspections are made.

Insulation Resistance

When an electrical circuit is found with a resistance to ground of less than 5 megohms, and a thorough cleaning does not bring it up, the motor, starter and wiring are separated and tested to find out which one is low in resistance. If the trouble is in the motor, it is cleaned and given a coat of insulating varnish with a spray gun. When the resistance is down to one or two megohms, the equipment is taken out of service and dried out if possible.

Since a new installation of wiring will test 100 megohms when new and in good condition, it is evident that the insulation is deteriorating when it drops below 5 megohms. In a paper mill a great deal of the wiring is in conduit in wet locations and buried in concrete floors. Rather than risk failure in service all 440-volt motor wiring is replaced when the insulation resistance to ground drops below 5 megohms. The power system is kept free of grounds. Occasionally a ground appears on the system, but a short-circuit has not occurred in any conduit line for three years. When a ground occurs on a circuit and is not readily removable it is cleared the following Sunday. Where the insulation value is allowed to drop too low, grounds are most likely to develop into a short circuit, especially if it is caused by moisture in the conduit.

Before written instructions were first provided for the workmen, occasional short circuits and flashovers occurred in starting boxes due to copper and carbon dirt collecting on the blade supports until a conducting path was established between phases. Now every time a starter is inspected these supports are wiped clean. This practice completely eliminated the internal trouble mentioned.

Preventing Insulation Failures

Another place for wiring failure is where it rests heavily on the conduit bushings in junction and switch boxes. The inspection instructions cover the elimination of this weak spot in the wiring. All motors and control equipment are protected against water by drip-proof covers.

Written instructions should cover all miscellaneous items that are usually overlooked or allowed to go too long before being given attention. It is a law that elevator-door safeties be kept in good working condition. To see that they comply with the law, state inspectors call at intervals to check up on them. As it does not speak well for the electrical department, nor for the plant, to have the safety devices inoperative when the inspector calls, they are put on the weekly inspection list. Sprinkler alarm bells should also be operative at all times, not only because they are frequently checked up by the insurance inspector, but as a fire-preventive measure.

The inventory of spare repair materials is carried in the plant store room and kept as low as possible, yet with enough to make the ordinary repairs and replacements. This makes it necessary to watch the supply closely in order to have materials on hand when needed.

Hoists are usually kept busy 24 hr. per day, 6 days per week, and they cannot be out of service for repairs very long at a time without creating inconvenience in materials handling. Written instructions are provided for the repairman in charge of the hoists. These instructions are intended also to assist him in their care and repair, so that reliable and uninterrupted service will be maintained and at the same time maximum safety will be afforded those who operate them. Before the instruction system was put into operation there were frequent delays, and the repair costs for both labor and material were high. Night calls for repairmen were frequent. These repairs usually meant substituting hand-operated chain blocks to replace a hoist while it was out of service.

Experience has shown about how long the bearings in motors will safely run without a change of oil. This period is incorporated on the chart and checked off when the oil is changed, to make sure that the allotted time is not overrun. No extra expense is incurred by changing the oil outside of the labor charge, as the oil is filtered and used in lineshaft bearings. Bearing failures due to belts being too tight have been completely eliminated by having the electrical operators tighten all belts.

At first an itemized maintenance schedule may appear bothersome or unnecessary, but after it has been in operation for a while one starts reaping the benefits, from managing the work rather than having the work manage the department. That a program can get results is proved by the fact that the electrical department in one plant is now operating at a yearly saving of around $7,000 for labor. Repair materials cost has also been substantially reduced. All this has been accomplished during a period when increased production was the watchword, thereby calling on the equipment for increased load.

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Pelton Couldn't Sell Eastern Rights for $2,000

On January 25, 1886, L. A. Pelton, inventor of the Pelton waterwheel, adopted all over the world for high-head water-power generation, offered to sell the territorial rights in the United States east of Montana, Wyoming, Colorado and New Mexico for the manufacture of his wheel for $2,000 net cash. His own words at that time were, "But so far I have not succeeded. . . . I would rather sell at that small price than have the trouble incident to manufacture and sale in Eastern territory."

At the time the offer was made the original patent, which was taken out October 6, 1880, had about eleven and a half years more to run. Mr. Pelton's offer was not accepted, and the following year all the patent rights were acquired by the firm of Rankin & Brayton, which operated a machine shop in San Francisco. From this modest start Pelton waterwheels have grown in size and importance until they are now made in single units with capacity as high as 70,000 hp. and operate under heads of more than a mile.

By H. B. CRANDALL
General Engineering Department
Westinghouse Elec. & Mfg. Co.

Umbrella-Type Generators Reduce Hydro Plant Costs

The construction of an umbrella-type slow-speed vertical-shaft waterwheel generator and space requirements: A comparison with machines of usual design

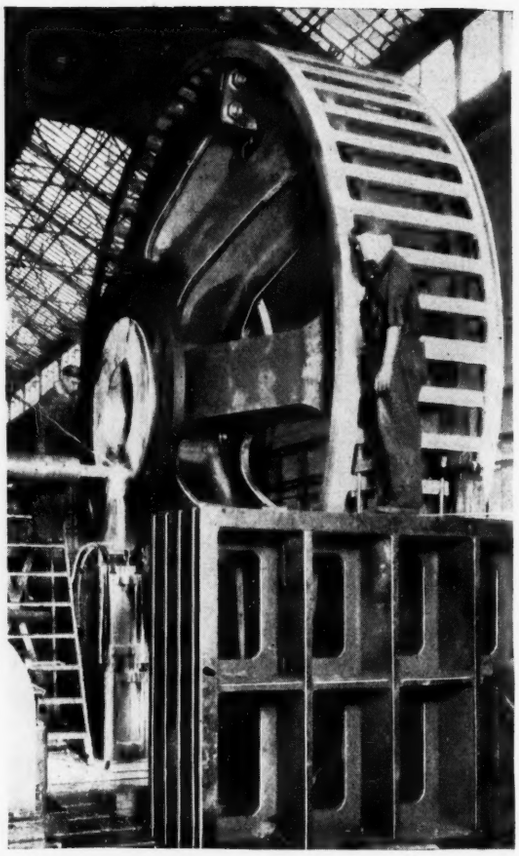


Fig. 1 — Machining the rotor spider for a large umbrella-type generator

DURING RECENT years a new design, the umbrella type, has come to dominate the field of vertical-shaft waterwheel generators. Machines of 1,000,000 kva. capacity have been built, against but 500,000 kva. for the older, two-bearing form, for the same period. The umbrella principle was employed as far back as the first Niagara Falls generators, built at East Pittsburgh in 1895, with external revolving field poles. These machines were not generally copied, and it is perhaps fair to consider the present popularity of the umbrella type from its recent introduction with an internal revolving field structure.

The modern umbrella-type generator involves a rotor with drooping arms that allow a combination guide and thrust bearing under the rotor hub and close to the plane of the rotor rim. With this construction no upper guide bearing is required, the machine is lighter, oil pumps and piping (ordinarily so complicated) are eliminated and the machine can be erected and dismantled in a much lower headroom. The rotor spider may be either cast or fabricated and either in one piece or split. Steel laminations are stacked on the periphery to form the rim. This rim is expanded by heat, and keys are driven between it and the spider, making the equivalent of a shrink fit.

The rotor is shrunk on to the shaft and is also held by vertical through bolts in a flange near the upper end of the generator shaft. The shaft is short, to facilitate erecting and dismantling; its lower end is flanged, and its upper end does not extend beyond the rotor hub. The bottom surface of the upper flange forms the running element of the thrust bearing.

When a main exciter is supplied, its shaft is smaller than the generator shaft, to which it is bolted. The pilot exciter shaft is smaller than that of the main exciter and is bolted to it.

A substantial saving in weight is realized in the umbrella-type generator, because the main supporting bracket is shorter. It rests on the foundation and does not span the stator frame, as is the case with the older two-guide bearing machine. In a machine without a direct-connected exciter the lower bracket is the only one used. If the exciter is attached, a light upper bracket is required, in which case the saving in weight is somewhat reduced. The thrust and guide bearings are below the rotor, so that the lower bracket supports the full weight of these bearings and that of the generator's rotor, and transmits this weight directly to the foundation on which it rests. In the older two-guide bearing machine, having the thrust bearing and one guide bearing above the rotor, the entire weight of these bearings and of the generator rotor rests on the upper bracket, and is transmitted from this bracket through the stator frame to the foundation (see Figs. 3 and 4)).

The combination guide and thrust bearing is the outstanding feature of the umbrella-type generator, Fig. 4. The Kingsbury principle, employing individual segmental shoes, is used in the guide as well as in the thrust bearing, with the result that one can stand as great pressures per square inch as the other. The guide bearing is above the thrust bearing, and makes contact with the outer periphery of the thrust bearing runner, an integral part of the shaft. This arrangement places the centerline of the guide bearing near the centerline of the rotor, and makes an upper guide bearing unnecessary. The thrust bearing rests on the lower bracket, and carries the

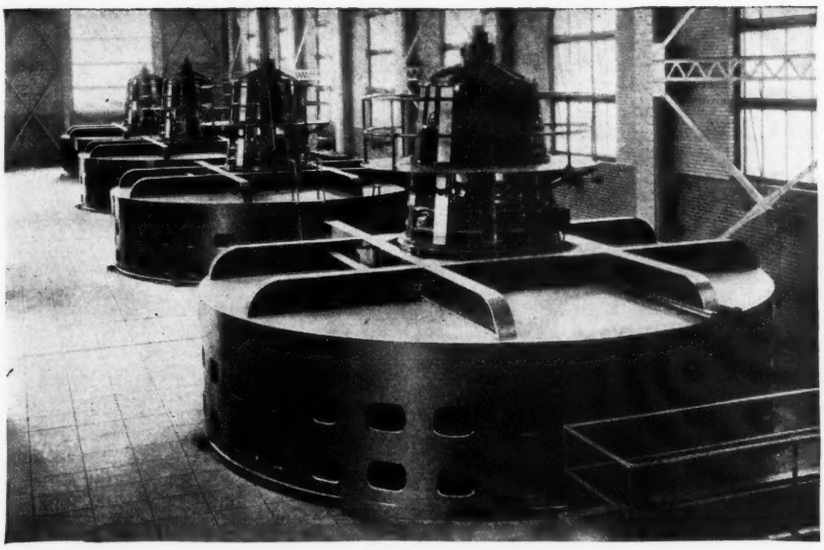


Fig. — Four 40,625-kva, 138.5-r.p.m. umbrella-type waterwheel generators installed in the Saluda plant of the Lexington Water Power Company, near Columbia, S. C.

entire weight of the generator rotor, shaft and waterwheel runner.

No oil-circulation system is required, because the bearing design makes it feasible to immerse both bearings in the same oil reservoir. The oil is cooled by water flowing through coils in the reservoir.

The appreciable saving in space and in station cost realized from an umbrella-type generator installation may best be shown by outlining the comparatively simple process of dismantling such a machine. The first step is to remove the pilot and main exciters, and the exciter bracket. Next, the rotor is disconnected from the shaft and raised to clear the top of the shaft and of the stator frame. The guide and thrust bearings are then taken out, after which the shaft is lifted straight up until it clears the lower bracket; then it is tilted and completely removed.

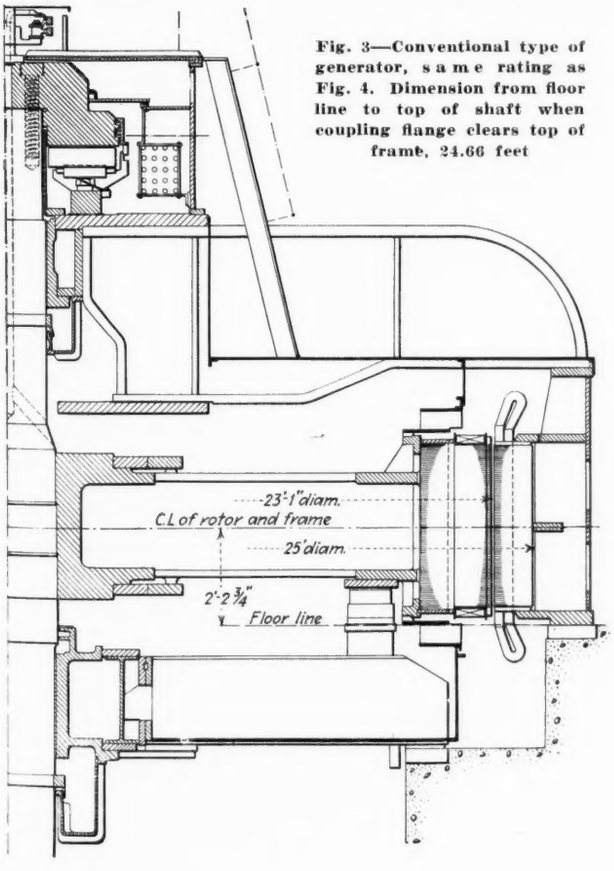


Fig. 3—Conventional type of generator, same rating as Fig. 4. Dimension from floor line to top of shaft when coupling flange clears top of frame, 24.66 feet

The process of dismantling the conventional two-guide bearing machine is considerably more complicated than that described for the umbrella type. In the first place, the conventional machine has a very long shaft which projects up beyond the upper bracket to give room for the thrust bearing and upper guide bearing, both of which are supported by the upper bracket. The first step in dismantling is to remove the pilot and main exciters, after which the thrust bearing and the upper guide bearing are taken out. Next the ponderous upper bracket is disconnected from the stator frame and raised up over the end of the shaft. Since the rotor cannot be disconnected from the shaft and removed first, it is necessary to lift them out together. Furthermore, the shaft is so long that a great deal of headroom is required in order that it may be raised to a sufficient height for the lower end to clear the stator frame.

The umbrella-type waterwheel generator is superior for applications requiring slow speed, large diameter machines. However, on small-diameter, high-speed machines, it is not so suitable because the guide bearing cannot be placed close enough to the centerline of the rotor to be effective, due to the fact that the small diameter does not permit sufficient droop in the spider arms.

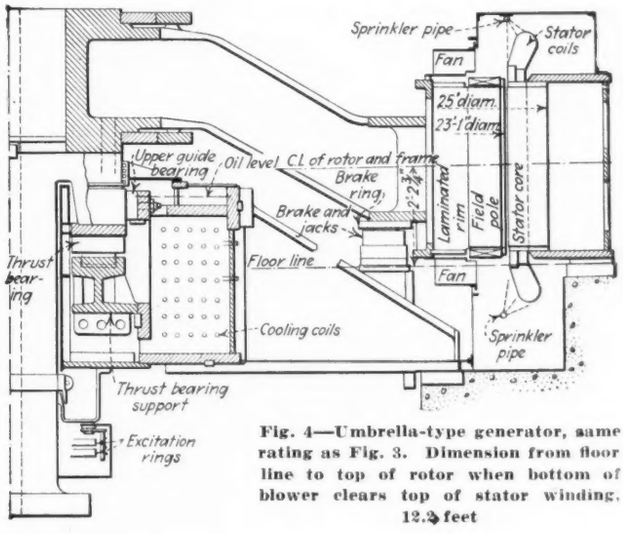


Fig. 4—Umbrella-type generator, same rating as Fig. 3. Dimension from floor line to top of rotor when bottom of blower clears top of stator winding, 12.3 feet

Building an Efficient Engineering Organization

How one large engineering and management corporation handles its engineering projects so that the work is properly coordinated and a check maintained at all times on the progress and cost

TO HANDLE large engineering projects successfully requires an almost infallible system of reports and records. At every step from the initiation to the completion of a project the work of the different interests and departments must be coordinated or there will occur costly errors and delays. How the engineering department of the Byllesby Engineering & Management Corporation, Chicago, Ill., handles its work is detailed in the following.

The system used is known as the Byllesby Standard Classification of Construction Accounts. Its purpose is to insure the best service to the clients of the engineering department, whether subsidiary and affiliated companies of the Standard Gas & Electric Company or independent of the latter. This is accomplished by establishing definiteness and continuity in the conduct of its engineering and construction work, thereby making possible prompt detection and correction of errors and misunderstandings otherwise likely to occur.

The means employed to do this include various uses of the standard classification of construction accounts so as to obtain uniformity of understanding and action on the part of all employees identified with the design and construction of a project, whether in the office or in the field. The successive stages in the progress of a project are thus tied together. Primarily, the system provides a record of expenditures on all projects on a definite basis that will permit costs of entire projects or of parts or units of these projects to be ascertained and to be used with confidence.

Its application to the processes incident to the completion of a project by the engineering department consists of separate, successive steps. These are briefly described in the following paragraphs, in their usual sequence, so that their relation to one another may be made plain:

1. Conferences between the client and representatives of the engineering department.
2. Reminder lists compiled and used by the engineers of the divisions concerned in the design of the project.
3. Scope sheets prepared by these engineers.
4. Estimates of cost prepared jointly by the same engineers, the construction superintendent and the production division.
5. Engineering, construction, material and drawing schedules prepared by the production division.
6. Requisitions on the purchasing engineer prepared by the engineers concerned in the design of the project.
7. Drawings detailed and completed by the design and drafting division under the guidance of the division engineers concerned in the design.
8. Weekly field progress letters from the construction superintendent.
9. Monthly field progress reports submitted by the construction superintendent.
10. Monthly quantity reports and completion forecasts submitted by the construction superintendent.
11. Construction-cost reports submitted by the construction auditor monthly.
12. Final combined quantity and cost reports compiled jointly by the construction superintendent and the construction auditor.

A conference is called, usually by the manager of engineering and construction, to consider the major features of engineering design and of every important project. The conferees consider the project by major and sub-major accounts, and the report or record of the conference state by their account numbers the conclusions reached for each major and sub-major account.

Reminder lists are used to determine the kind of equipment, materials and supplies to be requisitioned. They facilitate the preparation of the estimates and scope sheets and assist in eliminating omissions and errors. Items are given by account numbers.

The scope sheet is a description, in clear language, of the completed work to be provided under each major, sub-major and detailed account to be included in the estimate.

Estimates of cost (Fig. 1) employ the accounts of the standard classification of construction accounts to present indicative estimates of major accounts only; and for working estimates of major, sub-major and detailed accounts. All work schedules are subdivided to correspond with the accounts of the standard classification of construction accounts used in the scope sheets and estimates, by using the forms shown in Figs. 2 and 3.

Information for this article was supplied by General Charles Keller, Byllesby Engineering & Management Corporation.

B. E. & M. CORP. FORM 508-T-13

ACCOUNT		QUANTITY	UNIT COST	LABOR	MATERIAL	TOTAL

ESTIMATE FOR COMPANY DIVISION

WORK
LOCATION
ESTIMATED BY CHECKED BY APPROVED BY

PROJECT NO.
ESTIMATE NO.
DATE
PAGE OF PAGES

Fig. 1

MATERIAL SCHEDULE
B. E. & M. CORP. FORM 658-1

COMPANY PROJECT
WORK LOCATION COMPLETION DATE

ACCOUNT	MATERIAL	REQUISITION		CLEARANCE TO VENDOR		MATERIAL ON JOB		REQUISITION NUMBER	BIDS		PURCHASE ORDER			SHIPPING ADVICE		VENDOR AND REMARKS
		DATE REQUIRED	ACTUAL DATE	DATE REQUIRED	ACTUAL DATE	DATE REQUIRED	ACTUAL DATE		REC'D	RET'D	NUMBER	DATE	DELIVERY DATE	ADVICE DATE	SHIPM'T PROMISE	

REMARKS:

REVISION DATES: SHEET NO.

Fig. 2

JOB SCHEDULE
BYLLESBY E. & M. CORP. FORM 676

PROJECT NO. DATE 19

COMPANY DIVISION
WORK COMPLETION DATE

ACCOUNT NO.	DESCRIPTION												DRAWING REFERENCES	REMARKS

SIGNED PRODUCTION ENGINEER SIGNED CONST SUPT OR ENGINEER APPROVED MGR. OF ENGINEERING & CONSTRUCTION

Remarks—See Other Side

Fig. 3

REQUISITION ON PURCHASING ENGINEER
BYLLESBY E. & M. CORP. FORM 239-1

COPIES—2 to Design Division, 1 to Mr ORIGINATING ENGINEER to Mr. GEN. CONST. SUPT.

COMPANY FOR USE AT
DELIVER AT IN CARE OF
LISTED BY APPROVED BY

ITEM NO.	QUANTITY	DESCRIPTION OF MATERIAL	ACCOUNT NO.	REQUIRED DATE OF DELIVERY	PURCHASE ORDER NO.

PAGE OF PROJECT NO DATE REQUISITION NO.

Fig. 4

Fig. 1—Form on which estimates of cost are presented. Fig. 2—Material-schedule form. Fig. 3—Job-schedule form. Fig. 4—Purchasing order form issued by the purchasing engineer shows the account number and the requisition number of each item ordered

MONTHLY FIELD PROGRESS REPORT

SYLLESBY E. & M. CORP. FORM 802

FOR THE MONTH ENDING_____ 19____ DATE_____ 19____

AUTHORIZATION REFERENCE NUMBER_____

_____ DIVISION_____ COMPANY

LOCATION OF PROJECT_____

NAME OF PROJECT_____

THE UNDERSIGNED DESIRE TO REPORT THE FOLLOWING PROGRESS ON THE ABOVE NAMED PROJECT

FIELD WORK STARTED_____ 19____ PERCENT COMPLETED AS OF THIS DATE_____

ANTICIPATED DATE OF COMPLETION_____

IF ANTICIPATED DATE OF COMPLETION IS CHANGED GIVE REASON FOR CHANGE

APPROVED_____ SIGNED_____

GEN. SUPT. OF CONSTRUCTION — CONSTRUCTION SUPERINTENDENT

MAKE OUT REPORT WITH INDELIBLE PENCIL, INK OR TYPEWRITER

Fig. 5 (Left)—The monthly field-progress report states the work's progress in terms of the accounts entering into the estimate for the project to which the report relates

MONTHLY QUANTITY REPORT AND COMPLETION FORECAST

SYLLESBY E. & M. CORP. FORM 638-1

PROJECT NO._____ DATE_____ 19____

COMPANY_____ DIVISION_____

WORK_____

ACCOUNT NO.	DESCRIPTION	UNIT OF MEASURE	QUANTITY TO DATE	PROBABLE TOTAL QUANTITY	OFFICIAL ESTIMATE QUANTITY	% COMPLETE	ESTIMATED DATE OF COMPLETION

SIGNED_____ ENGINEER IN CHARGE OF STATISTICS — APPROVED_____ CONSTRUCTION SUPERINTENDENT

PAGE____ OF____ PAGES

Fig. 6

CONSTRUCTION COST REPORT

SYLLESBY E. & M. CORP. FORM C-6

COMPANY_____ DIVISION_____

I. R. NO'S	LOCAL W. O. NO'S

E. C. NO.? CHI. W.O.?_____ REPORT AS OF DATE_____

WORK_____

ACCOUNT	ACCOUNT NAME	COST TO DATE			PROBABLE TOTAL COST	OFFICIAL ESTIMATE
		LABOR	MATERIAL	TOTAL		

PAGE____ OF____ PAGES SIGNED_____ CONST'N. AUDITOR_____ GEN'L. SUPT. OF CONST'N.

Fig. 7

FINAL COMBINED QUANTITY AND COST REPORT

COMPANY — WORK — PROJECT NO.

DIVISION — DATE OF STARTING CONSTRUCTION — DEPT. REQ. NO.

DATE COMPLETED — DATE OF REPORT

ACCOUNT NO.	ACCOUNT NAME	QUANTITY (EXPRESSED IN APPROPRIATE UNIT)	DIRECT COSTS				INDIRECT COSTS (DETAIL ON REVERSE SIDE)	GENERAL COSTS	GRAND TOTAL
			LABOR	MATERIAL	TOTAL	UNIT COST			

PAGE OF PAGES SIGNED_____ CONST'N AUDITOR_____ GEN'L. SUPT. OF CONST'N

Fig. 8

DETAIL OF INDIRECT COSTS

ACCOUNT NO.	CONSTRUCTION EQUIPMENT	LOCAL TRANSPORTATION	TEMPORARY ROADS AND RAILWAYS	TEMPORARY SERVICE FACILITIES	CONSTRUCTION CAMP	CONCRETE INDIRECT	INJURIES AND DAMAGES					TOTAL INDIRECT COST	

Fig. 8-A

Fig. 6—Monthly quantity reports and completion forecasts are stated in terms of the accounts shown in the estimate. Fig. 7—Construction-cost reports are stated in accordance with the accounts shown in the estimate. Fig. 8—Front of final combined quantity and cost report sheet. Fig. 8A—Form on the back of Fig. 8

The account number of each item requisitioned on the purchasing engineer is supplied by the author of the requisition, on the form in Fig. 4. Purchase orders issued by the purchasing engineer show the account number and the requisition number of each item ordered.

Each final drawing issued to the construction superintendent is required to bear, in the lower right corner, the account number of the major or sub-major account of the standard classification of construction accounts of the part of the project shown in the drawing. This number is shown as the numerator of a fraction whose denominator is the key number of the drawing.

When weekly field-progress letters are required to be submitted, they are stated in terms of the account numbers of the items mentioned in the letters. The monthly field progress reports, Fig. 5, state progress in terms of the accounts entering into the estimate for the project to which the report relates.

Monthly quantity reports and completion forecasts, Fig. 6, are also stated in terms of the accounts shown in the estimate. They provide means for a comparison between the quantity of work done and that shown in the estimate to be done.

Construction-cost reports, Fig. 7, are stated in accordance with the accounts shown in the estimate for the project. They enable actual costs for labor and material to be compared with the estimated costs.

Final combined quantity and cost reports, Fig. 8, give an analysis of the completed project and show the final quantities and costs for each account and subaccount of the estimate for the project.

Thus the system establishes a definite and direct connection between the various operations required for the completion of a project and provides a uniform method for recording progress and handling details from the inception of a project to its completion. This system tends to improve the service to the client and to promote his satisfaction with it by:

1. Fixing the major features of a project as definitely as is possible in advance of the study and comparison of sufficiently detailed plans, and is done through conferences.

2. Causing the estimate and the detailed plans to conform with the recorded conference agreement. The reminder lists, scope sheets, estimates and drawing produce this result.

3. Coordinating the activities of all concerned in completing the project. The schedules and field progress reports and their follow-up processes accomplish this coordination.

4. Giving timely notice of impending overruns or underruns and preventing unauthorized work, thereby removing the most common causes for criticism and dissatisfaction. The comparison by accounts of work done and expenditures made as shown in the monthly reports of cost and progress and their comparison with the official estimate are the means for accomplishing these ends.

Only the principal elements of the system have been given. They are sufficient however, to show the basic importance in it of the standard classification of construction accounts and the manner in which this classification is used to promote certainty and efficiency in the work of the engineering department. The system includes other less important elements and it is supplemented by "Office Procedure," a code applicable to the Chicago office of the engineering department and its branches and auxiliary forces and "Field Organization Standards," instructions for the guidance of all organizations engaged in field work.

A Standard Boiler Water Condition

The author proposes a standard boiler water containing four grains per gallon of caustic alkalinity and eight grains of non-caustic alkalinity. This is to be accompanied by a blowdown equalling one-fifth of the make-up

By J. B. SWIFT

General Manager
Henszey De-Concentrator Company

TODAY the enlightened steam-boiler operator tries to maintain a certain definite water condition in the boiler. He knows that hardness can form scale. Precipitated impurities can form mud deposits. Large amounts of soluble matter, or comparatively small amounts of insoluble matter, will cause priming. Absence of caustic alkalinity may allow pitting, while high caustic concentration may cause embrittlement.

Engineers operating chains of boiler plants now know that, although no two waters are alike one definite specification can be given as to the kind and quantity of certain constituents of boiler water, so that troubles such as scale, priming, mud deposits, corrosion and embrittlement cannot exist.

Years ago it was known that if the water were softened, hard scale probably would not be formed, although there still might be mud deposits. It was known that more or less blowing down every day was necessary, otherwise the boiler might prime, or it might develop dangerous mud deposits. It was known that acids and dissolved air caused corrosion, and that excess caustic might cause embrittlement. I was understood, therefore, that certain undesirable conditions were to be avoided, and it was thought that there was a certain desirable condition that should be maintained. The proper condition, and simple means for maintaining it, had not been adopted until recently.

Some boiler-water troubles, and the necessary conditions that should be maintained in the water in the boiler to prevent them, are:

Scale from permanent hardness can be prevented by using sufficient chemical treatment, so that an excess of about 5 to 10 gr. per gallon of sodium carbonate (or equivalent) remains in the boiler.

Scale from temporary hardness will usually be eliminated by the ordinary heat of the boiler. The presence of 1 to 5 gr. per gallon of caustic alkalinity is advisable.

Mud deposits can be prevented by the maintenance of a sufficiently low concentration of suspended or precipitated matter, and by keeping it in circulation.

To avoid priming and dirty steam the blowdown, preferably continuous and automatic, should be sufficient to maintain the concentration of suspended matter and soluble matter well below the priming point, determined by trial.

Corrosion caused by air can be prevented by boiling and venting the feed water. The maintenance of a slight degree of causticity in the boiler water eliminates most of the other causes of corrosion and pitting.

Caustic embrittlement is guarded against by maintaining the concentration of caustic low, and in any case maintaining it lower than the sulphate plus the

non-caustic alkalinity. Caustic embrittlement is seldom encountered with low concentrations of caustic alkalinity, when the pressures are under 200 pounds.

The writer is in contact with concerns having many boiler plants. Usually, boiler-water tests are made at each plant, but no record or report is required. Other concerns have reports of the boiler water tests sent to the main office daily. Certain companies check over more than 10,000 analyses in the course of a year, and the experience of these firms is interesting.

Years ago each plant was given individual and special attention, and an individual treatment was worked out. The final results, however, were only fair. It was soon noticed that although many kinds of treatment were used the plants getting the desired results all had practically the same final condition of the water in the boiler. The instructions to the plants were therefore changed to specify the condition that should be maintained in the water in the boiler, and the simplest water treatment that would produce this condition was used.

Instructions to the plants were first to treat the boiler water so that the alkalinity, as indicated by phenolphthalein, P, would be slightly greater than one-half of the alkalinity indicated by methyl orange, M. Briefly, P should be a little greater than $\frac{1}{2}$ M. This would indicate that both sodium carbonate and sodium hydroxide would be present, and, roughly, meets the conditions specified relative to permanent and temporary hardness. It is evident that these instructions were incomplete.

After a few thousand daily analyses were checked over, the question as to what chemical and physical condition was wanted clarified itself. The plants that maintained about 4 gr. per gallon of caustic alkalinity, and about 8 gr. per gallon of carbonate alkalinity, and with a low concentration of impurities, got the best results as to clean boilers, clean steam and absence of corrosion. Those having the lowest concentration had the best results.

Concentration means the ratio of the degree of impurity of the water in the boiler to the degree of impurity of the make-up water. For example, if the make-up water contains 2 gr. per gallon of chlorides, and the boiler water contains 8 gr. per gallon of chlorides, then the boiler water has four concentrations. The chlorides were selected as a basis for determining the concentration because chlorides remain in solution. Instead of the chlorides test, a better means of controlling concentration is to maintain the ratio of the quantity of make-up to the quantity of blowdown, so that it is equal to the number of concentrations desired. This automatically produces the desired concentration, and if the concentration is too great, the rate of blowdown can be increased.

The frequent statement that every boiler water must be treated differently is misleading many operators of small plants to believe that boiler-water troubles can be avoided only with great difficulty and expense. The fact is that with a little instruction from an engineer experienced in this art they can easily and inexpensively avoid all boiler-water troubles arising from impurities.

A boiler-water condition fitting so many cases that concerns having nation-wide distribution of plants have adopted it as standard is: 4 gr. per gallon of caustic alkalinity, 8 gr. per gallon of non-caustic alkalinity, and 5 concentrations. This might be varied to include nearly all conditions by specifying: 1 to 8 gr. per gallon of caustic alkalinity, 4 to 20 gr. per gallon of non-caustic alkalinity, and 3 to 10 concentrations. Maintain the A.S.M.E. or N.E.L.A. sulphate-alkalinity ratio.

So long as this standard boiler-water condition is maintained it is a rare case where scale, priming, dirty steam, corrosion, embrittlement, or other trouble is found. To maintain the foregoing condition easily and economically there is needed a simple water-testing kit for determining the condition existing in the boiler, so that the several constituents can be increased or decreased by feeding the proper chemicals. Intelligent operators can easily be taught to make these water tests.

To maintain the proper concentration it is desirable to provide modern means for regulating the rate of blowdown so that it is proportioned to the rate of feeding of impurities into the system. It is necessary to provide heat exchangers, or other means, for salvaging the heat of the blowdown.

It is, of course, desirable to provide meters for measuring the blowdown water, as well as the make-up and feed water, so that the operator can be fully informed.

▼

Organ-Type Console Controls Lighting Effects

BY MEANS of vacuum tubes, a light artist at the color console of the Severance Memorial Hall, Cleveland, Ohio, has hue and intensity of auditorium and stage lighting at his finger and toe tips, just as a pipe organist finds

The use of grid glow tubes makes possible the unusual compactness of this console type lighting control

pitch and volume of sound at his command. The unique lighting switchboard, designed and manufactured by the Westinghouse Electric & Manufacturing Company, is built into an ordinary organ console, wherein a new means of governing the grids of vacuum tubes enabled engineers to concentrate the nerve centers of nearly 4,000 lighting combinations.

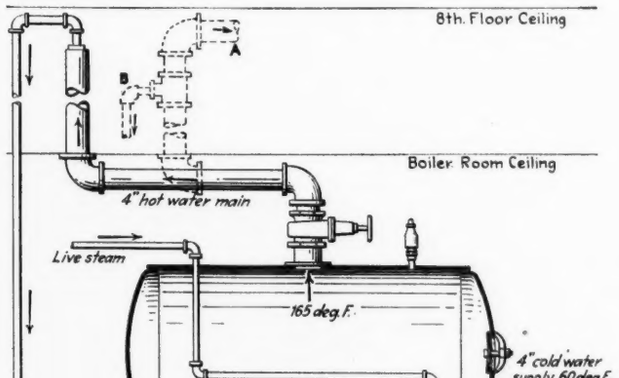
...RIGHT OUT OF THE PLANT...

How Faulty Water Circulation Was Improved

IN THE article by Leslie W. Ross, in the July 7 number, "How Faulty Water Circulation Was Improved," it was stated that the circulation was improved without the installation of a circulating pump by simply installing a valve (at point *C* in his article) and then blowing down each morning until the water had circulated from the tank to the top of the building and back to the point of the blowoff.

I do not see where the system is much improved, when it is necessary each morning to take time and trouble to draw the amount of water necessary to start a circulation. My ideas as to how the system could have been permanently corrected to operate at all times without the necessity of closing valve *C* and drawing water until circulation was started up on the return piping is indicated by the dotted lines on the accompanying illustration.

Referring to Mr. Ross' sketch [which is reproduced herewith], it will be seen that the return from the top of the line back to the hot-water tank has been taken



Arrangement of circulating pipe with suggested improvements shown by dotted lines

above the supply to the fixtures. This, in my opinion, is wrong, for the reason that an air pocket is formed and no way is provided for relieving air when the faucets are open on any fixture. If the line was installed as shown at points *A* and *B* circulation would take place as soon as the water was heated in the tank. At *D* I have shown the correct location of the returns from the building entering the hot-water tank. In the arrangement shown by Mr. Ross the return is close to the cold-water inlet, and the cold-water supply to the tank therefore has a tendency to act as a check against the return hot water from the building entering the tank freely. This will not take place when the return to the tank is connected at the end opposite the cold-water supply.

I also question if the return line back to the boiler is large enough in view of the supply to the building being 4 in. This return line should not have been installed any smaller than 1½ in. for the size of hot-water supply.

New York City. V. J. CUCCI,
Kimball & Cucci, Consulting Engineers.

Raw-Water Ice Without Air Agitation?

IN HIS ARTICLE in the July 7 number W. F. Schaphorst seems to take the stand that raw-water ice made without air agitation would necessarily be unsanitary. In my opinion it should be possible to make sanitary ice with or without agitation, or it is possible to have contaminated ice though agitation is employed.

It is true, of course, that a high mineral content in the water will cause white or opaque ice in the absence of agitation. It is commonly stated that this white color is due to impurities in the water. But impurities consisting of mineral salts should not be confused with bacterial contamination. In fact it is often the case that the mineral impurities in water are of actual benefit to the health. Calcium salts are recognized as a necessity in the human system, and such alkaline salts as sodium carbonate are known to be of value in maintaining an alkaline condition in the blood, essential to normal health.

The average ice plant uses water from the city supply, often with additional treatment to remove some of the mineral salts. Even without further treatment the ice would contain only the minerals normally found in the city water, which cannot be considered objectionable from the standpoint of sanitation. The contamination which Mr. Schaphorst expects in the absence of agitation should not necessarily be present. In the first place, only germ-free water should be used for can filling. In the second place, there is small chance of contamination in the properly operated plant. Attendants should walk over the tank top only when necessary and should then be sure that their shoes are clean. How many consumers would care to use ice from a plant in which air agitation was the only safeguard against dangerous contamination? Or

how many of us would care to use ice from a plant in which it was considered a normal occurrence for filth to fall from the operators' shoes into the ice cans?

It is true that natural ice is barred in some communities. But it must be remembered that most streams show a high bacterial content and are really dangerous as a source of ice; not because the water freezes without agitation but because the water is impure to begin with.

Perhaps Mr. Schaphorst's statement that "all impurities that find their way into the ice can are held in suspension until the cores are pulled" is a little too-inclusive. Anyone who has thawed a piece of ordinary raw-water ice and tested for minerals can testify that an appreciable portion of the original mineral content of the water is still present in the ice. I have made this test repeatedly and have always got positive results, even in plants where vigorous agitation is employed. This indicates that a portion of the mineral impurities have been frozen in the ice. I am not so sure but that the same thing might be true in the case of microscopic organisms. I do believe that agitation would lessen the number of organisms frozen in the ice, but I am not convinced that it would furnish complete assurance against such a possibility.

The fact that minerals readily freeze into the ice in spite of agitation is further demonstrated by the difference in the qualities of the ice produced from waters having different salts in solution. It is common knowledge that ice made from water high in carbonates is very brittle. Yet when, by chemical treatment, the carbonates are changed into sulphates the same water will yield a tough ice.

We might thus conclude that agitation does not afford complete assurance against impurities in the ice. In fact, we might take the opposite view and hold that contamination might be introduced with the air itself. In most low-air-pressure plants no effort is made to filter or scrub the air before it is introduced into the cans. If we assume 0.5 cu.ft. of air per minute per can and a freezing time of 50 hr., we find that a total of 1,500 cu.ft. of air has been scrubbed by the 300 lb. of water. Many microscopic organisms are dust-borne, and it is entirely possible that they might thus be introduced into the cans.

Again we must remember that even where agitation is employed and cores are pulled a negligent and uncleanly plant crew could easily contaminate the can after coring. Such possibilities show that the best guarantees against contamination necessitate using only sanitary water to start with and exercising every sanitary precaution during the freezing and harvesting of the ice.

It is conceivable that we shall some day see ice produced without even ice cans, much less agitation. Likely some compact form of ice freezer will be developed, perhaps along the lines of the flake-ice machine. Ice will be made in small flakes at a very rapid rate and pressed into blocks of the desired size. Sanitary water will be used and the danger of contamination during freezing will be negligible. The consumer will not worry about the mineral content of the ice so long as it is no higher than that of the regular water supply. All of the ice produced in this manner will, of course, be opaque, yet an educated public will not question its quality. Transparency will no longer be considered a criterion of purity, nor should it be. As already pointed out, ice may be clear and yet have minerals or other impurities frozen in it, or again it may be opaque and yet contain no impurities whatever. A ball of virgin snow is opaque, not because of impurities but because of the way that the snow crystals refract the light.

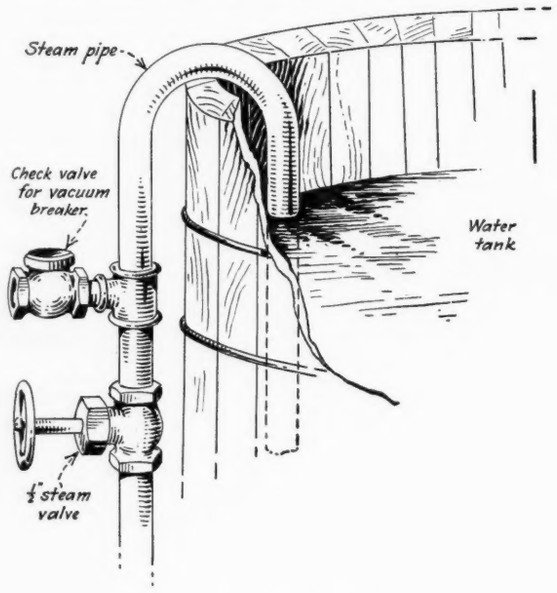
Though anyone familiar with raw-water ice making realizes the extent to which the clearness of the block is dependent upon the proper agitation, it is perhaps going too far to claim that a sanitary product is impossible without it.

M. F. KNOY.

Beaumont, Texas.

Steam Heater for Exposed Water Tanks

ON PAGE 783 of the May 19 number a practical steam heater for exposed tanks was illustrated and described. Some years ago we were bothered with a tank freezing up; so we bent a length of ½-in. pipe into the water tank and connected it with the steam supply. A check valve was connected into the line between the regular valve and tank to prevent a vacuum from forming in the pipe after the steam was closed off and drawing water into the pipe. A small opening of the steam valve kept the water from freezing.



Small steam line used to heat tank

W. A. COOIL.

Ladysmith, B. C.

Rise of Pressure in Boiler-Feed Line

A QUESTION was discussed in the Aug. 4 number regarding the rise of pressure in a feed line when the feed water regulator is closed off with increasing loads.

If the pressure is caused by the rising characteristic of a centrifugal pump as the load is reduced on the pump, it is, of course, possible to reduce the pressure by increasing the load on the pump through a relief valve, as has been suggested. This method, however, increases the load on the pump, and consequently the horsepower, which may be a considerable item of expense if these conditions occur frequently or continue over a length of

time. Also, a relief valve operating at high pressures will require considerable maintenance.

A better method is to install a reducing valve on the discharge of the pump which will maintain a constant pressure in the feed line or constant pressure above the boiler pressure at all times. The use of a reducing valve does not increase the danger of the pump churning and overheating, as this condition will be the same whether or not a reducing valve is used. If this tendency is already present it can only be corrected by providing for the discharge of some of the water pumped, in which case the relief valve must be used. Usually there is enough leakage through the feed water regulator valve to remove sufficient heat generated in the pump to prevent any difficulty.

The saving in power through the use of a reducing valve will in most cases offset the greater cost of a reducing valve over a relief valve.

Erie, Pa. V. V. VEENSCHOTEN.

I HAVE READ with interest the answers to H.R.L.'s question in the Aug. 4 number of *Power* and note each author has assumed the type of pump to be centrifugal. That may be so; but if the pump is centrifugal I do not believe any one of the answers was wholly correct.

I think H.R.L. will find his pump speeds up with the decrease of feed-water demand to the boilers. Consequently, the pressure rises proportionately with the increased speed. This increase is due to the lighter demand and consequent unloading of the driving unit.

It is characteristic of a centrifugal pump to drop off in power consumption as the main discharge valve is closed. When the valve is completely closed, the load is the mechanical friction of the unit as a whole plus the friction of churning the water. The water friction tends to produce heat rapidly, causing the impeller and sealing rings to expand, which, in turn, start to rub the surrounding casing. This sets up more friction, which, when allowed to run long enough, will finally freeze or seize the impeller.

There is no danger of excessively high temperature immediately. Unless the pump parts are fitted extremely close, ten or fifteen minutes' running with no discharge should not cause dangerous overheating.

The theory M. F. Knoy offers has no direct bearing on the matter, merely causing what we generally term a water-hammer where the valve closes suddenly.

I do not believe there would be an appreciable difference in pressure between the check valve and the boiler over the discharge pressure of the pump. The check valve under such a condition could not possibly close quickly enough to maintain the difference in pressure. I do not recommend a relief valve on the discharge of the pump and returning it to the intake. This arrangement would merely tend to increase the load on the pump during the interval it would normally be unloaded and would only serve slightly to retard heating of the water and pump.

H.R.L. has really nothing to worry about unless the interval of zero demand is of long duration. I believe his pump is steam-driven and if the pressure is the only part of the condition that puzzles him, he should work on the governor.

If, on the other hand, it is a direct-current motor and speeds with the decreased load, then he may find trouble in the shunt field. If his pump is a positive-pressure type, closing of the discharge would naturally build up pressure sufficiently to stall the pump-driving unit. In either case an increase in head is to be expected. If his pump is centrifugal and runs at all times at exactly the same speed when discharge is completely shut off, then the total pressure will not vary from 700 to 750 lb. In other words, all conditions being the same, the pressure will come to exactly the same head every time the discharge valve is completely closed. E. E. MERRELL.

Elizabeth, N. J.

Making Insulation Tests With a Megohm Meter

REGARDING the question in the June 16 number of *Power*, the megohm meter is usually bought for a definite purpose and this determines the meter's voltage. For example, the American Telephone and Telegraph Company specifies a 400-volt generator for testing telephone cable, and the A.I.E.E. recommends 500 volts for making insulation-resistance tests. Some large power companies are testing insulators on high-tension lines with 1,000-to-2,500-volt meters. Therefore consideration should be given to the megohm-meter voltage when testing insulation, if correct results are to be obtained.

Some engineers who have studied insulation-resistance measurement say that a meter of over 500 volts should not be used on 110- or 220-volt apparatus when the insulation is not in good condition. I am using a 500-volt meter to test insulation on rotating apparatus of 110 to 6,900 volts and use a 1,000-volt meter on a 25,000-kva. 13,800-volt generator with satisfactory results.

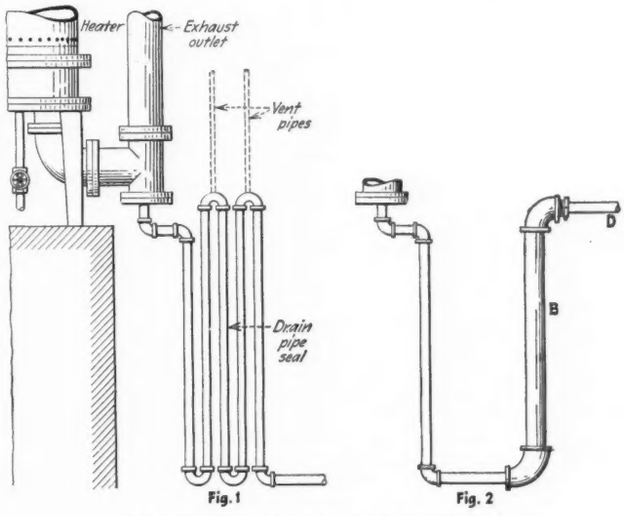
Great Falls, Mont. B. W. HAMILTON.

Venting Drain Pipe Seal

REFERRING to the description of the drain pipe seal shown on page 925 of the June 9 number, I fail to see the need of four pipes. One would, in my opinion, be equally effective.

Fig. 1 of the accompanying illustration shows the vent seal as suggested in the letter referred to and Fig. 2 a seal using only one pipe. Where one pipe is used, as at *B*, it should be at least $1\frac{1}{4}$ in. in diameter. If outlet *D* is open no air vent will be necessary.

Toronto, Ont. JOHN THORN.



Multiple- and single-loop drain pipe seal

From Among Readers' Problems

Conducted by
L. H. MORRISON

TEMPERING SLACK COAL—*We are burning slack coal on our chain-gate stokers and find it necessary to temper the coal, but have great difficulty in wetting the coal uniformly. Where in the path of the coal, from the unloading bunker to the stoker hopper, is the best place to apply the water?* A.R.K.

It is difficult to temper coal uniformly by applying the water to it either in the weigh larry or stoker hopper. If the coal is conveyed from the point of unloading to the overhead bunker by a type of conveyer that discharges through a spout, the water is best applied by means of a fine spray nozzle to the coal stream as it leaves the spout. If the conveyor dumps the coal directly into the bunker, good results are had by spraying the water over the cone formed by the coal. In either case it requires practice to get just the right amount of water, but this is simplified by keeping the conveyor running at full capacity. By applying the water to the coal in the bunker it tends to permeate the mass and any excess moisture will be drained away before the coal is used. In any case the water should be broken up in a fine spray and directed on the area covered by the dropping coal.

—❖—

AMMETERS READINGS DO NOT CHECK—*In our plant we charge 84 vehicle batteries from a 115-volt direct-current circuit at night. There is an ammeter on the main charging line. A throw-over switch on each panel allows checking on one ammeter, the rate of charge to the batteries. When the charging current to each battery is read on this meter and totaled the result does not agree with the reading of the ammeter in the main line. For example, the total charging currents as obtained for the individual batteries is 650 amp. when the main-line ammeter reads 1,100 amp. What causes this difference in the readings? The ammeters were calibrated and were found to be correct.* R.F.M.

If the ammeter in the battery circuits is reading correctly and does not total up to the same value as the totalizing meter there may be something wrong with the connection. The sum of the readings of the individual meters should at least approximate that of the totalizing meter.

It may be possible that the contact resistance of the switches, when thrown to the position that puts the ammeter in circuit, is higher than when they are in the opposite position. If this is the case, it will reduce the charging rate when the ammeter is in circuit. When the switches are in the position to obtain the ammeter reading there may be some additional resistance in the circuit that is not present when the switches are in opposite position, for example, the ammeter shunt and other connections. All of these would tend to reduce the current when taking readings.

Are the same leads being used on the ammeters that were used when they were calibrated? Changing the leads between the meters and their shunts, or changing their length, will affect the calibration of the meters. The same leads, without any change, should be used to connect the meters to their shunts on the switchboards that were used when they were calibrated. In some cases to make a good looking job of the wiring on the back of the switchboard, the leads from the ammeters to their shunts are cut to the required length. Doing this may cause a considerable error in the meter reading.

PREVIOUS QUESTION
DISCUSSED BY READERS

THE QUESTION

UPON reclaiming a surface condenser not used for several years but which formerly operated under a heavy overload we find that the tubes are coated on the circulating-water side with about a ⅛-in. layer of hard scale. What is a practical method of removing this scale? Can it be satisfactorily dissolved with an acid, and if so how should it be done? A.M.D.

UNDOUBTEDLY the scale in this condenser is largely composed of calcium carbonate and calcium sulphate and it can be easily removed by the use of muriatic acid and water, using a solution of 2 or 3 per cent strength, that is, 2 or 3 gal. of acid to 100 gal. of water.

It is desirable that the condenser be shut off from the rest of the pipe system if at all possible; if the inlet and outlet pipes have valves in them near the condenser these can be closed; otherwise I recommend that blind flanges or steel plates be placed on the inlet and outlet flanges of the condenser.

A vent should be provided at the top of one of the waterboxes and left open to provide a free passage for the gases that will be given off. This should be at least ¾-in. pipe.

Two openings should be provided in the divided waterbox, one on the bottom and one on the top, so that a pump or ejector can be used to circulate the solution by drawing it out of the bottom and discharging it into the top, if the condenser is of the two-pass type. If of the single-pass type it will be necessary to draw out of one end and discharge into the other.

The acid and the water can be mixed continuously in a wooden barrel and allowed to flow by gravity into the upper waterbox, or may be pumped in by the pump or ejector. We are using a small centrifugal pump of about 100 to 150 gal. per minute capacity with 2-in. pipe connections for condensers of 14,000-sq.ft. size for circulating the solution, the solution entering the condensers by gravity into the top bank of tubes first.

It is necessary that the solution fill the condenser full so the top rows of tubes receive the solution while it still has considerable strength. If the tubes are packed on the ends with the old style corset lacing packing with ferrules, the acid will destroy nearly all of the packing and it will be necessary to repack them. However, there are packings on the market that will withstand the acid.

If an ejector is used the water will soon get very hot, but it will do no harm and the solution will be far more active and work at lower strength. Even if a pump is used it would be desirable to warm the solution to around 130 or 140 deg.

The solution will soon lose its strength and will no longer dissolve the scale. Draw a glass of it out and pour it on some clean pieces of scale or concrete free from oil, when it should boil or gas if not too weak.

For scale ⅛ in. thick I believe that at least 2 carboys of acid will be re-

quired for each 1,000 sq.ft. of tube surface to be cleaned. As long as the solution gases out of the vent it is acting on the scale and is getting weaker all the time. Examination of the heads and tube ends may show them to be clean, but there may still be scale in the middle of the tubes.

Detroit, Mich. GEORGE DREYER.

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THERE ARE a number of methods of removing scale in condenser tubes that have been used with varying success. However, since the case mentioned is one of unusual severity due to neglect, many of these methods would not be applicable.

The method suggested, namely the use of an acid as a solvent, would not prove a practical solution of the problem. The cost of such an attempt would be prohibitive, since special apparatus would have to be developed for introducing the acid and a large quantity of the solvent would be necessary for removal of the amount of scale present. In addition, the element of danger would be introduced.

I believe that the most effective method would be "sand-blasting," that is, shooting a mixture of sand and water through the tubes by compressed air. No elaborate apparatus is necessary, as the "gun" used can be easily made up in the plant. It is simple in construction, consisting of a reservoir for the sand, a nozzle, connections for the air and water and valves for controlling them. By varying the proportion of sand and water the abrasive action may be increased or decreased. The scouring action of the sand effectively cuts the scale and the loosened scale and sand are sluiced out by the water.

This method of removing scale from condenser tubes is being used with excellent success on several plants of my knowledge. After trying almost every known method of scale removal they adopted this as the simplest, cheapest and most effective. While the tubes in question, due to their bad condition, will take an unusually long time to return to original condition, nevertheless I believe that the method outlined will prove the cheapest and most practical.

Bellerose, L. I. H. C. OATLEY.

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WE ARE USING an evaporator condenser with San Francisco Bay salt water as the cooling medium. The temperature of the steam entering the condenser for ten months has varied between 190 and 250 deg. and is usually at about 230 deg. The cooling water entered the condenser at 60 deg., and usually left at 180 deg. The relatively high temperatures, compared to turbine condenser operation with steam below 100 deg., caused a hard scale to build up quite rapidly and bake to the interior of the tubes. Naturally, the scaling was most severe at the top pass, where the steam first hits the tubes.

Our condenser has four passes of $\frac{5}{8}$ in. O.D., 18-gage admiralty tubes, the three lower passes of which were cleaned, with some difficulty, by a spiral wire brush from which water is discharged within the tubes during the cleaning process of pushing the brush through the tubes. The scale was baked onto the upper pass tubes so hard that four men could not shove the brush through these tubes even though the maximum outside diameter of the brush was about $\frac{1}{8}$ in. less than the inside diameter of a clean tube and the brush also was tapered.

We purchased a motor-driven cleaner with a drill-type cutting head through which water is discharged while revolving and being shoved through the tube. Feeling that the scale was baked onto the upper tubes so hard that this cleaner would damage them, due to the severity of cleaning necessary, we purchased spare tubes to replace all the upper pass tubes. To our surprise we found that with this cleaner we were able to clean 16 tubes 9 ft. long in 18 min. These tubes were in the top row and the most difficult to clean. They were cleaned perfectly and not damaged.

The scale in this condenser is calcium and magnesium, salts of carbonate and sulphate and possibly combined with some silicate and iron oxide. The condenser referred to in the question is probably scaled with similar salts. The method outlined above is so simple and thorough with no detrimental effect to the tubes that the author can recommend it as a most practical method.

H. J. BYRNE.

San Francisco, Calif.

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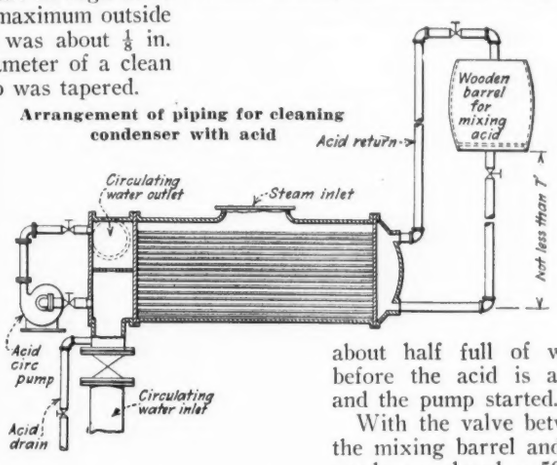
SCALE may be effectively removed from surface condenser tubes by acid cleaning. In the case mentioned, where the condenser has been out of service for several years and the scale has become dried out and hard, acid cleaning would seem to me to be the most feasible.

Where the scale is hard, mechanical cleaning is apt to rupture the tubes. In cases of this kind it is usually advisable to use acid, or acid followed by mechanical cleaning after the scale has become loosened and disintegrated.

Apparatus for acid cleaning of surface condenser tubes that has been successfully used with good results is shown in the accompanying sketch.

For calcium carbonate scale ordinary commercial hydrochloric acid is used and practically all hard condenser scales are of this composition. To prevent violent action, the condenser should be about half full of water before the acid is added and the pump started.

Arrangement of piping for cleaning condenser with acid



With the valve between the mixing barrel and the condenser closed, a 50 per cent solution of hydrochloric acid is prepared in the barrel. When the pump has been started the valves between the mixing barrel and the condenser may be opened and the acid mixture fed slowly into the condenser. The acid concentration at the pump discharge should not exceed 4 per cent in order that the metal of the condenser be not attacked. As the strength of the solution becomes depleted more acid may be added to the barrel.

After all action in the condenser has ceased the condenser should be flushed out thoroughly with clean water until no trace of acid remains.

It is important that the solution in the condenser be circulated; in fact the secret of success with acid cleaning is to provide a positive circulation of the acid solution at all times.

P. K. RICHARDSON.

Salt Lake City, Utah.

A Question for Our Readers

THE CONDENSATE from our heating system returns to a receiver tank from which it is removed by a vacuum pump and delivered to an open feed-water heater. The pump operation is controlled by a float valve in the receiver. We find that with this arrangement the pump operation is very irregular. When it stops exhaust steam is wasted to the atmosphere and when running the feed-water temperature is low. What can we do to secure more steady operation?

L.M.D.

Suitable answers from readers, if received promptly, will be paid for[1] when published.

▼

[1]As an alternative to cash payment for answers published, readers may select any one of the following boooks. (Be sure to state the book desired):

Morrison's *American Diesel Engines;* Walker and Crocker's *Piping Handbook;* Norris and Therkeisen's *Heat Power;* Emswiler's *Thermodynamics;* Church's *Steam Turbines;* Uehling's *Heat Loss Analysis;* Croft's *Steam Power Plant Auxiliaries and Accessories;* Powell's *Boiler Feed Water Purification;* Osborne's *Power Plant Lubrication;* Moyer and Fritz' *Refrigeration;* Rietschel-Brabbee's *Heating and Ventilation;* Annett's *Electric Elevators.*

WHAT'S NEW IN PLANT EQUIPMENT

Ratio Meter for Gas- and Oil-Fired Furnaces

A RECENT ADDITION to the line of combustion instruments put out by the Bailey Meter Company, Cleveland, Ohio, is the ratio meter for use as a combustion guide in the firing of gas- or oil-fired heaters, and all types of industrial furnaces.

Referring to the illustration, the meter contains two recording pens. One records the rate of oil flow and is actuated by a simple mechanical type of mechanism which receives its motive power from the differential pressure produced by an orifice in the fuel line. In similar manner, the shorter pen records the flow of air to the furnace. At the time the meter is being installed a complete combustion test is run on the furnace to determine what ratio between air flow and fuel flow corresponds to best combustion conditions, and the air-flow mechanism is then adjusted so that this ratio is always obtained when the two records coincide, one upon the other.

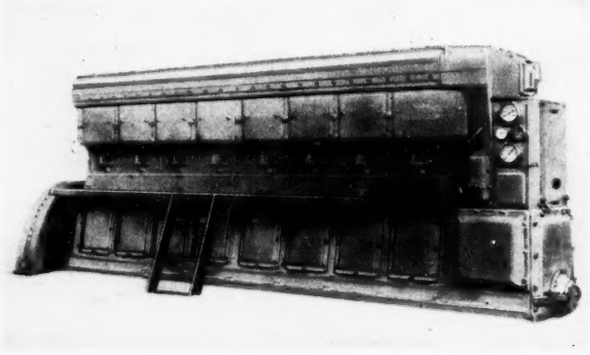
In addition to serving as a combustion guide, the ratio meter serves as a fluid meter on the fuel line. It records and indicates the rate of flow, and the total flow may be given by the four-dial integrator, which may or may not be installed in the meter, as desired.

The meter has been so designed that it is possible to install auxiliary recorders of temperature or pressure to give records of these factors on the same chart with the flow records. Each factor is recorded in an individual color.

Bailey ratio meter

Stationary-Type Diesel Engines

PLACING of the spray valves and driving levers directly beneath the camshaft in place of on the cylinder head, as is the usual practice, is an important feature of Type JT diesel engine developed recently by the Cooper-Bessemer Corporation, Mount Vernon, Ohio. This innovation allows the engine head to be removed without touching the spray valve and injection setting.

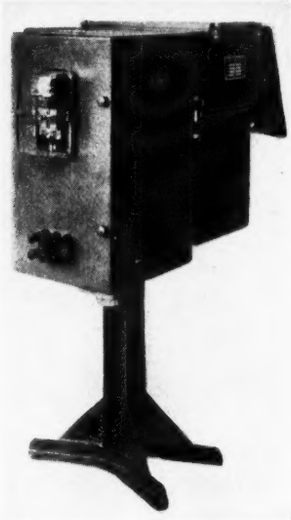


Type JT diesel engine made in three-, four-, six- and eight-cylinder combinations

Made in cylinder numbers of three, four, six or eight the horsepower ratings are from 150 to 480 when operating within the speed range of 300-360 r.p.m. The cylinders have 11½-in. bore and a 15-in. stroke. The crankshaft has a diameter of 8 in. in both main and pin bearings. Connecting rods are drop-forged I-beam section. Power cylinders are liners of nickel iron, and gray-iron pistons are used. For high-speed work either alloy pistons or combination iron skirt and alloy head pistons are furnished. Special type of cylinder heads carry single-intake, exhaust, air-starting and relief valves, all seated in removable cages.

Metal-Clad Switchgear for Controlling Motor-Driven Auxiliaries

A NEW type of single pedestal-mounted metal-clad switchgear particularly designed for controlling motors of auxiliary equipment, such as circulating-water pumps, ash-sluice pumps, coal-crusher equipment, deepwell pumps, ventilating and draft fans, is now being put out by the Delta-Star Electric Company, Chicago, Ill.



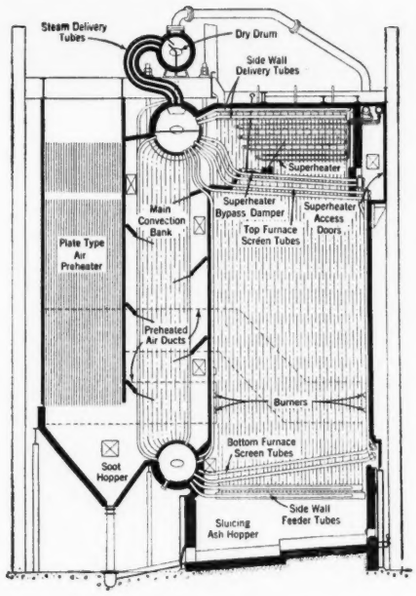
Pedestal-mounted metal-clad switchgear

In this switch the solenoid and manually operated circuit breaker is equipped with current transformers mounted in a compartment the swinging door of which carries a temperature relay and current calibrating terminals. When short-circuit protection is desired additional relays are mounted just below the temperature relay.

The incoming supply cables enter through a compartment near the top and the load cables leave at the bottom through a terminator.

Standardized Steam Generator

A STANDARD steam-generating unit built in various sizes and providing a wide range of capacities at any desired conditions of steam temperature and pressure is now being offered by the Com-



Steam generator made in capacities from 70,000 to 400,000 lb. of steam an hour

bustion Engineering Corporation, 200 Madison Ave., New York City. Designs have been completed for eight sizes, with capacities ranging from 70,000 to 400,000 lb. of steam an hour.

The design represents a compact and simple arrangement, all pipes and headers essential for completing the circulating system of water walls are located entirely within the casing and there is no need for openings through the casing. It is made air-tight and dust-tight throughout.

All four walls of the furnace are water-cooled, each wall being composed of a solid row of tubes, with only sufficient space between them for construction requirements. The water-wall feeder and delivery tubes, at the bottom and top of the furnace, respectively, complete the heating surface of the furnace proper, nearly all of which is exposed to radiant as well as convection heat. The furnace is arranged for corner-tangential firing with pulverized coal.

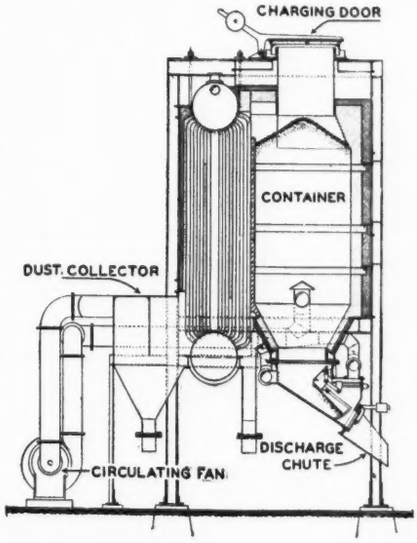
An important feature of the unit is the superheater bypass damper, which affords a means of controlling superheat temperature. Adequate space is provided for the superheater, which is so located in the assembly as to permit of simple supports and maximum accessibility.

Steam-Generating Dry-Quenching Unit

AN IMPROVED TYPE of unit for the dry quenching of coke has been developed by the Dry Quenching Equipment Corporation, 200 Madison Ave., New York City, for use in coal-gas plants where the quantity of coke produced per day is relatively small.

This unit consists, essentially, of a brick-lined container and a water-tube boiler of the bent-tube type, both inclosed in a steel-plate, gas-tight housing built integral with the main supporting members. The boiler consists of two drums, connected by a bank of tubes baffled for three passes of the circulating gas. The tubes of the front row forming one wall of the container are faced with cast-iron blocks. The remaining three walls are built of hard-burned fire-brick, tied into the steelwork by three courses of holding file. The entire container is backed with a suitable thickness of insulation.

The motor-driven fan unit which circulates the cooling gas is located on the ground level adjacent to the dust collector. The charging door is of the water-sealed type, and is operated through a motor and speed-reducer unit. This arrangement provides a means of interlocking its operation with the discharge drive and with the drive of the charging device used to transport the hot coke to the container. The unit is



Cross-section of dry-quenching unit

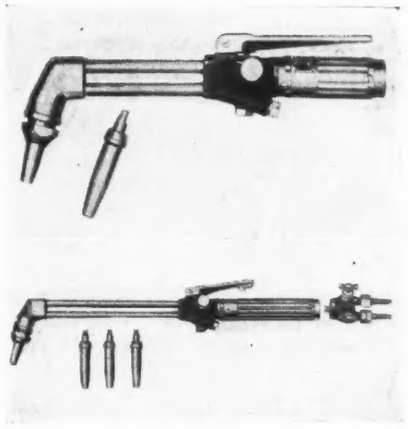
designed to produce approximately 950 lb. of steam per ton of coke cooled for a power consumption of less than 3 kw.-hr. per ton.

Oxy-Acetylene Cutting Apparatus

CUTTING blowpipe Type C105 and cutting attachment Type CW105 are recent additions to the line of medium-pressure apparatus of the detachable valve-body design put out by the Linde Air Products Company, 30 East 42d St., New York City.

By means of the detachable valve body, the operator can change easily and quickly from a full-size welding blowpipe to a smaller welding blowpipe, to a full-size cutting blowpipe, or to a cutting attachment without detaching the hose or hose connections and without the use of a wrench.

The locking device for connecting the detachable valve body to any one of these blowpipe handles consists of a locking bolt and wedge-shaped locking screw. The locking screw is operated by turning a ring, and draws the detachable valve body and blowpipe handle together, making a gas-tight joint. The ring can also be used for hanging up the blowpipe when not in use.



Types C105 and CW105 cutting equipment

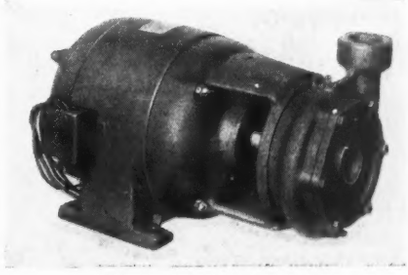
The blowpipe is furnished as standard with four cutting nozzles and a 75-deg. angle head. If required, a 90-deg. angle head can be furnished. The CW105 cutting attachment is of single-joint design and attaches directly to the valve body.

Unit-Type Pumping Unit

WIDE APPLICATION in the industrial field is claimed for the Monobloc (Type D) centrifugal pumping unit recently introduced by Worthington Pump & Machinery Corporation, Harrison, N. J.

The pump is bolted to the extended motor frame and the impeller is mounted on the end of the continuous motor shaft. The bronze impeller incorporates the shaft sleeve as an integral part. The special cadmium-plated steel locking device for the impeller, the forged bronze packing gland, and the arrangement of shaft water-throwers are important features of the pump.

The unit is designed for a wide range of service and can be used as a built-in part of assembled equipments, such as air-conditioning apparatus, filters and filter systems, core-sucking units and others. It can also be used for general

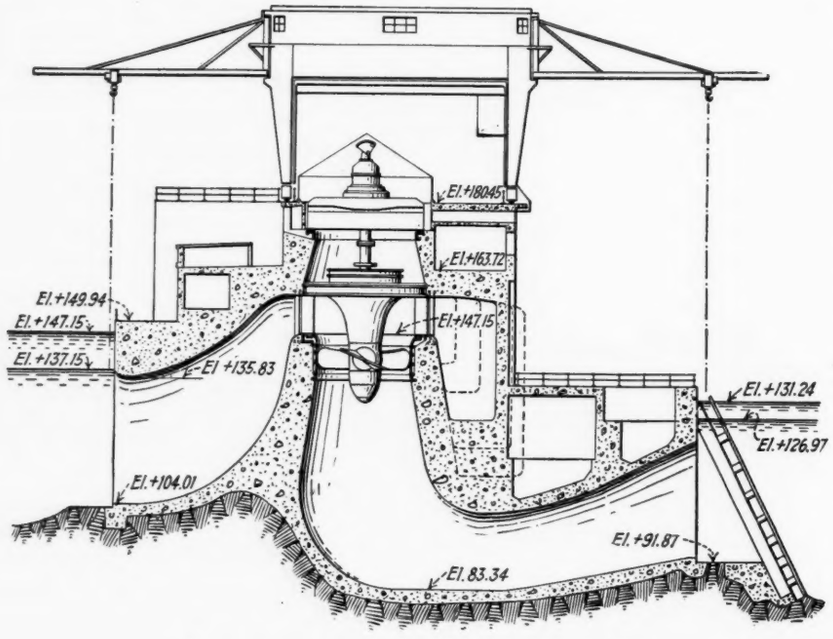


Worthington Type D pumping unit

house service, ice water and brine circulation, booster service for sprinkler systems, in the petroleum industry and for general industrial service. Capacities range from 10 to 150 g.p.m. in heads up to 80 feet.

NEWS of the FIELD

Swedish Plant Will Use Largest-Diameter Hydro Turbines Above Head-Water Level



Cross-section of turbine installation in Vargon plant

TWO OF THE largest-diameter vertical-shaft hydro-electric units have just been ordered by the Royal Board of Water Falls, Sweden, for installation in the new government power plant at Vargön on the Gotha River. This plant will be at the outlet from Lake Vänern, the third largest lake in Europe with an area of 2,165 square miles, and will be part of the scheme to regulate the discharge of the lake through the Gotha River. It is planned to store water when power requirements are low and use it for peak demands.

The turbines, which will measure 26 ft. 3 in. in diameter, will be installed above the head-water level, as shown in the cross-section drawing. This is the first time that such an arrangement has been attempted, other than on a very small scale. Exhaustive experiments, however, have convinced the designing engineers that the arrangement will be entirely reliable. In operation the space between the head-water level and crown plate is evacuated causing the water to rise and fill this space. The turbine gates are then opened and the water rushes through the turbine, drawing any remaining air with it and completing the syphon.

Several advantages are cited for this unique installation. Placing the turbines above head-water level will eliminate the necessity for sluice-gates at the entrances to the scrolls, and will materially reduce cost of excavation. Furthermore, it makes the development of very low-head falls economically possible.

In the Vargön plant the turbines will have a minimum output of 13,500 hp. each, with a maximum of 16,000 hp. each on a net head of 14 ft. 1 in. and a speed of 46.8 r.p.m. Each unit will utilize 9,900 sec.-ft. of the flow. Both turbines will be of the Kaplan type, with runner blades and gates automatically adjusted by an oil-pressure governor. The runners will weigh 150 tons each, and the complete turbine about 650 tons. The gates will be 34 ft. 3 in. at the largest diameter, and the main shafts, of hollow construction, will be about 3 ft in diameter, with solid forged flanges for coupling to the generators. The latter will be placed on the roof of the structure, protected only by a plate casing.

Of the two turbines now on order, one will be made by Nydqvist & Holm at Trollhättan, and the other by Verkstaden at Kristineham. Ultimately, when regulation of Lake Vänern is completed, two more units will be installed. Excavations for the plant have been going on for some time now, and the steel plate linings for the draft tubes will be grouted next September. It is expected that the erection of the turbines will be started in May, 1933, and the first installation complete by the fall of that year.

Largest Government Steam Contract to New York Corp.

THE LARGEST CONTRACT for the supply of steam ever signed by the United States Government has just been awarded to the New York Steam Corporation, according to a recent announcement of that company. Involving all present and future buildings of the Treasury Department in Manhattan, the agreement provides for an ultimate supply of 500,000,000 lb. of steam annually to meet heating and service requirements.

The buildings to be served include the new Parcel Post Building now under construction, the Pennsylvania Post Office Building and its proposed annex, the Downtown Post Office Building, Federal Court House, Sub-Treasury Building, Appraisers' Stores Building, Custom House, Government Warehouse, the new Assay Office Building, the proposed Federal Court Building and the proposed Federal Office Building.

With the exception of the contract for the New York Central Railroad group of buildings, which involved 1,500,000,000 lb. of steam annually, the government contract is said to be the largest ever received by the New York Steam Corporation.

Power Topics Discussed at A.I.E.E. West Coast Meeting

SEVERAL PAPERS of interest to power engineers were presented at the Pacific Coast convention of the American Institute of Electrical Engineers, which was held at Lake Tahoe, Calif., Aug. 25-28. Electric power in the wood products industry was the subject of a paper, which brought out the fact that over two billion kilowatt-hours a year is used in the pulp and paper and lumber industry in Oregon, Washington and Idaho, a usage equivalent to the entire central station output in those states. Greater use of power in converting

every part of the tree into commercial products was held to be the solution to the grave situation that confronts the industry. Less refuse for steam electric generation in isolated plants will open a large field for central station power.

By adding resistance and reactance to the rotor circuit of slip ring motors the torque and speed characteristics of the steam engine have been duplicated and electric drive may now be safely applied to mud pumps used in oil-well drilling without danger of damaging the pump due to high torque of the ordinary induction motor in case of stoppage in the mud flow. This new development was brought out in a paper on oil field applications and showed that the new motor will stall at 250 per cent load and so remain for hours without serious overheating.

Of interest to hydraulic and electrical engineers was the report of a test made on a large hydraulic turbine-driven generator to determine stray load losses under short circuit and at rated load. Heretofore it has been necessary to base full-load stray losses on short-circuit losses which left doubt as to the exact horsepower delivered to the generator shaft by the turbine at full load. Calorimeter measurements showed remarkable agreement between stray load losses under the two sets of conditions, and the electrical engineer is now able to assure the turbine manufacturer as to the exact horsepower input to the generator shaft. This is of importance since a premium is often placed on turbine efficiency and the only means of determining prime mover efficiency is by the electrical output of the generator.

N. Y. Commission Voids 400 Power Contracts

BECAUSE they conferred special rates and privileges at variance with the published rate schedules, the Public Service Commission of New York on Sept. 2 voided more than 400 contracts between public utilities and large power consumers in the state. The commission held that a private contract providing for a rate different from that filed with it for a similar type of service is illegal, and ordered that all contracts made henceforth must conform to the regular rate schedules.

While most of the contracts voided had been made by utilities operating upstate, the commission found sixteen special contracts in New York City that did not agree with the regular schedules. These included one between the Brooklyn Edison Company and the Bush Terminal Company; another between the Queens Electric Light & Power Company and Patrick McGovern, contractor for the 40-mile water tunnel being built from the Catskill Mountains to the city; and a third between the United Electric Light & Power Company and John Roebling & Sons, builders of the new George Washington Bridge across the Hudson River.

Heat Values of Fuels Discussed at Meeting Of American Chemical Society in Buffalo

OF THE MANY PAPERS read and discussed at the 82nd meeting of the American Chemical Society, which was held in Buffalo, N. Y., Aug. 30 to Sept. 4, five presented before the Division of Gas and Fuel Chemistry were of particular interest to the power field.

Dealing with the thermodynamic principles involved in the determination of the difference between gross and net heating values for both constant-volume and constant-pressure combustion of solid and liquid fuels, the paper by L. C. Lichty and B. L. Brown suggested that a mean value of 970 B.t.u. per pound of water vapor formed be used as the difference for constant-volume bomb determinations, and that for constant-pressure combustion in air of 100 per cent humidity or less the difference is practically 1,070 B.t.u. per pound of vapor formed. For other than 100 per cent humidity the difference may be anything from 1,070 to 0 B.t.u., it was stated.

In a paper on "Net and Gross Heating Values, Their Definition and Proper Use," Horace C. Porter pointed out that many liquid and gaseous fuels are charged with a gross value 6 to 12 per cent higher than the net, while with the average solid fuel the difference is only 4 per cent; efficiencies on the net basis, therefore, are more favorable to the former than to the latter. "Our definition of net," he said, "must involve some arbitrary correction factor, that is, it cannot be made to express an average effective heating value obtainable in practice. In choosing the factor we can only adopt that figure expressing most nearly the heat actually derived from condensation under the bomb conditions, and must not assume that this gives a value that can be made effective in practice. Its purpose is simply to give a truer comparison of inherent fuel values."

The effect of hydrogenation upon a representative Eastern and a Western bituminous coal was described in a paper by H. K. Benson, W. L. Beuschlein, B. Christenson and C. C. Wright. The conclusion was that American bituminous coals, both Eastern and Western, compare very favorably with European coals with respect to hydrogenation. Likewise, A. W. Gauger, J. R. Taylor and C. W. Ulmen, in their paper on the effects of blending and mechanical pressure on the coking of Dakota lignite, reported that a firm dense coke could be produced from a carbonized 30 to 70 mixture of Pocahontas coal and lignite char, and that a dense firm anthracite-like material could be made from lignite by the application of high mechanical pressures during heat treatment at 500 to 600 deg. Centigrade.

That coal is a colloid has been assumed on the basis of absorption phenomona, X-ray investigation and examination of very small particles under the ultramicroscope. Investigations by means of new methods by vertical illumination, particularly as used in the Spierer lens, however, not only give conclusive evidence of the colloidal nature of coal but also show the arrangement and the size of the micollae in coal, Reinhardt Thiessen stated in his paper entitled "The Physical Structure of Coal." The micollar arrangement in coal, as far as preserved, is similar to that of the plant tissues from which the coal was derived, he said.

Workman Call Off Strike at Hoover Dam

CONSTRUCTION WORK on the Hoover Dam project is once more proceeding at its regular rate. The workmen, who were on a strike at the dam, voted Aug. 16 to call off the strike. As a consequence, work proceeded as usual during the week following.

At the close of work on Aug. 22, the Nevada adit was in 120 ft. from the intersection of tunnel No. 2. (See *Power*, March 17, 1931, page 434). The Arizona adit had progressed 404 ft. from the intersection with tunnel No. 3. Tunnel No. 2 has been driven 147 ft. upstream from the Nevada adit and 223 ft. downstream. Tunnel No. 3 is in 250 ft. upstream and 400 ft. downstream from the Arizona adit.

New Chicago Post Office Will Have 45 Elevators

SPEED AND SAFETY have been combined in the mechanical and electrical design of the 45 elevators to be installed in the new Chicago Post Office which is to be completed within the next 900 calendar days. Twenty-four of the elevators will be used for passengers and the other 21 for freight.

According to Frank C. Reed, vice-president of the Westinghouse Electric Elevator Company who were awarded the contract, eighteen of the freight elevators will have a carrying capacity of 10,000 lb. at a speed of 500 ft. per minute. The travel one way is from 100 to 175 ft., or a round trip travel of 200 to 350 ft. Two of these elevators will be arranged to handle 12,500 lb. at a reduced speed. The other three freight elevators travel two floors at 175 ft. per minute with a load of 8,000 lb.

Twelve of the passenger elevators will be used by patrons of the Post Office and will carry a normal load of 2,500 lb., or seventeen passengers, at a speed of 600 ft. per minute. They will have a one way travel of 160 to 175 ft.

The remaining passenger elevators

will be for use of the employees. Three will have 3,000 lb. capacity at a speed of 600 ft. per minute and travel 155 ft. one way. Six will have a 4,500 lb. capacity at a speed of 600 ft. per minute and travel 155 to 175 ft. one way. There will be three small geared elevators with capacities of 1,000 to 2,500 lb. and speeds of 200 to 350 ft. per minute and travel one way of 24 to 150 feet.

Latest safety devices both mechanical and electrical will be incorporated in these elevators. Twenty-one of the passenger elevators will have electrically-operated car and corridor doors, which will open as the car stops automatically level with the floor landings. Eighteen of the freight elevators will have electrically-operated car gates and corridor doors.

It is estimated that the 45 elevators will travel, in one day's time, approximately 700 miles. The cost of the entire installation is $739,500.

$300,000,000 College Plan Proposed to Aid Jobless

As a step in relieving unemployment and the economic depression, Harvey N. Davis, president of Stevens Institute of Technology, suggested that the colleges of the country embark on a $300,000,000 building and upkeep program. In an address before the economic conference held last week under the joint auspices of the alumni of Stevens and Columbia University at Stevens engineering camp, he called on philanthropists to contribute this sum for the much needed improvement of American universities.

Mr. Davis proposed that $200,000,000 be spent for new buildings and $100,000,000 for the maintenance and repair of old ones. This sum, he said, would be "considerably larger than the emergency public works appropriation recently voted by Congress. And there are ways in which two or three times this sum could be advantageously spent if it were available. There is no question but that this means of combating hard times could be made large enough to materially influence the coming business revival if potential benefactors, public and private, choose to do so."

Commission Receives Seven Bids for Muscle Shoals

Only seven proposals for the leasing and operation of the Muscle Shoals power and fertilizer plants were received by the new Muscle Shoals Commission on Sept. 1, the day specified for the submission of bids. Practically every one of these proposals is of a tentative nature, due to the fact that the commission had announced that the offers could not be binding without the approval of Congress. None of the bids was accepted, and the commission decided on Sept. 2 to extend the time for receiving additional proposals until Nov. 1.

Those who have submitted bids so far are: Alabama Power Company; Tennessee Electric Power Company; Davison Chemical Company, Baltimore; Chemical Development Company, New York; Bailey Furnace Company, Canton; F. E. Castleberg, Shreveport; and Lloyd H. Smith, Battle Creek.

After conferring with President Hoover, members of the commission stated that the President still favors the use of the Muscle Shoals properties principally for the production of fertilizer. This brought a reply from the fertilizer industry, charging the Administration with deliberately ignoring the fact that the only modern feature of Muscle Shoals was the power plant and that its potential usefulness for the production of fertilizer lies in the past.

COMING CONVENTIONS

American Society of Mechanical Engineers. Regional meeting in Kansas City, Mo., Sept. 7-9. Annual meeting in New York City, Nov. 30-Dec. 4. Secretary, Calvin W. Rice, 33 West 39th St., New York City.

American Association of Engineers. Seventeenth annual convention at Huntington, W. Va., Sept., 28-30. Secretary, M. E. McIver, Willoughby Tower, Chicago, Ill.

American Institute of Electrical Engineers. District meeting at Kansas City, Mo., Oct. 22-24. Annual winter convention in New York City, Jan. 25-29, 1932. Secretary, F. L. Hutchinson, 33 West 39th St., New York.

American Welding Society. Fall meeting at the Copley-Plaza Hotel, Boston, Mass., Sept. 21-25. Secretary, M. M. Kelly, 33 West 39th St., New York City.

Association of Edison Illuminating Companies. Forty-seventh annual meeting at The Greenbrier, White Sulphur Springs, W. Va., Sept. 21-25. Secretary, Preston S. Millar, 80th St. and East End Ave., New York City.

International Railway Fuel Association. Annual convention at the Hotel Sherman, Chicago, Ill., Sept. 15-16. Secretary, C. T. Winkless, Room 700, La Salle Street Station, Chicago, Ill.

National Association of Power Engineers. Annual convention and mechanical exposition in the Convention Hall, Kansas City, Mo., Sept. 7-11. Secretary, Fred W. Raven, 417 South Dearborn St., Chicago.

New England Water Works Association. Fiftieth annual convention at the Hotel Statler, Boston, Mass., Sept. 29-Oct. 2. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Southwest Power Conference and Show will be held in Convention Hall, Kansas City, Mo., Sept. 7-11. Secretary, George F. Klein, Chamber of Commerce, Kansas City, Mo.

Third International Conference on Bituminous Coal. At Carnegie Institute of Technology, Pittsburgh, Pa., Nov. 16-21. Chairman, Thomas S. Baker, president of Carnegie Institute of Technology.

Personals

Gardner C. George, formerly superintendent of drafting of the New York Power & Light Corporation, has been appointed mechanical and civil engineer of the company. Previous to his connection with the New York Corporation, which dates from Sept. 25, 1929, Mr. George was chief designing engineer of the Power Corporation of New York, and before that he had spent a year in Mexico, designing hydro-electric plants for the Mexican Northern Power Company.

A. C. Willard, professor of heating and ventilating and head of the mechanical engineering department at the University of Illinois, has been named chairman of a special heating, ventilating and air-conditioning committee to cooperate with the White House conference in Washington, D. C., on home building and home ownership.

F. M. Plake, of Kansas City, has resigned as chief engineer of the Missouri Public Service Commission, effective Oct. 1, to become valuation engineer of the Union Electric Light & Power Company of St. Louis. Mr. Plake has been with the commission for ten years, serving as chief engineer for the past four and a half years. J. E. Flanders, of Paris, Mo., has been appointed chief engineer to succeed Mr. Plake. Mr. Flanders has also been with the commission for ten years, during several of which he has held the position of assistant chief engineer.

Otto Nonnenbruch, chief engineer of the diesel department of I. P. Morris & De La Vergne, Inc., for the past four years, and prior to that with the Worthington Pump & Machinery Corporation in various capacities for nine years, has rejoined the latter's organization as special sales representative with headquarters in Buffalo, N. Y.

Evart L. Henderson has resigned as general superintendent of the Washington Court House district of the Dayton Power Light Company to enter the engineering department of the United Gas Public Service Company, with general offices in Houston, Texas.

Obituary

E. Fenton Gilbert, president of the Dampney Company of America, Hyde Park, Boston, Mass., died suddenly last week of a heart attack, at his summer home on Cape Cod. He was 45 years of age, and was a native of Jamestown, N. Y. Mr. Gilbert was widely known in steam power plant engineering circles. He graduated from the Sheffield Scientific School at Yale University in 1907, and was a member of the American Society of Mechanical Engineers.

Business Notes

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J., announces the following changes in sales personnel: J. B. Allen, formerly president of the Allen Engineering Company, Bridgeport, Conn., has been appointed special marine representative with headquarters at Harrison; H. G. Wood, formerly assistant manager of the New England division of the Westinghouse Electric & Manufacturing Company, has joined Worthington as electrical sales engineer; E. M. Paullin, Jr., who has been associated with the New York office of the General Electric Company as synchronous motor specialist, has been appointed electrical sales engineer of the Cincinnati works of the Worthington company; John T. Clancy, assistant manager of the Buffalo works sales division, has transferred his headquarters from Buffalo to Harrison; E. W. Hammond, formerly located at Buffalo, has been transferred to Los Angeles as special representative of diesel and gas-engine sales on the Pacific Coast; A. M. Boehm, formerly in the sales department at Buffalo, has been sent to Kansas City as diesel and gas-engine specialist; Joseph F. Hecking, formerly with the diesel-engine sales division in New York, has been assigned to the diesel and gas-engine sales division at Buffalo; William J. Daly, assistant manager of the Cincinnati works sales division, has been sent to Pittsburgh on special sales work; G. A. Herrmann, formerly sales engineer at Chicago, has been appointed acting district manager at St. Paul; and W. R. Kennedy, sales engineer at Pittsburgh, has been appointed acting district manager at Kansas City.

FULLER LEHIGH COMPANY, New York City, announces the removal on Aug. 28 of its Boston office from 80 Federal Street to 49 Federal Street. H. H. Leathers continues in charge of the office as district sales manager.

AMERICAN SMOKE & SOOT WASHER COMPANY, New York City, announces the removal on Sept. 1 of its general office from 55 West 42nd Street to the General Motors Building at 1775 Broadway, New York City.

EASTON CAR & CONSTRUCTION COMPANY, Easton, Pa., has purchased the industrial division business of the Lakewood Engineering Company. Hereafter the complete line of Lakewood trucks, trailers, skids and industrial cars will be manufactured at Easton, it is announced, and replacement parts for present equipment may be obtained from the Easton company.

L. MUNDET & SON, INC., of Texas, announces the removal of its Houston office from 2420 Nance Street to its new building at Commerce and Palmer Streets. This company also handles products manufactured by Keasbey & Mattison, of Ambler, Pa.

How's Business?

BUSINESS apparently gave this August up as a bad job, according to *The Business Week*, Sept. 9. The general level of production, construction and trade as measured by our weekly index averaged about 5 per cent below July and by the end of the month fell to the lowest point of the depression. Securities markets showed reassuring ability to resist unfavorable news, but the business momentum which normally accumulates in August for fall activity was feeble. Steel production gave no indications of impending expansion in any line of demand, except possibly structural requirements for public works, the full force of which is being postponed by political inertia and stupidity. General building operations remained at low levels, and the usual seasonal rise in electric power and coal production was absent.

Production of electricity by public utilities for the week ended Aug. 29 was 1,637,533,000 kw.-hr., according to N.E.L.A. figures. This is 0.5 per cent above the previous week and 3 per cent below the corresponding period of 1930.

Trade Catalogs

CONDENSERS, COOLING TOWERS AND PUMPS — Three new publications on steam condensers, water cooling towers and air pumps have just been issued by the C. H. Wheeler Manufacturing Company, Philadelphia, Pa. The first is an exceptionally well presented treatise on the design and operation of jet and surface condensers and auxiliary equipment. The second describes and illustrates the construction and applications of natural and forced-draft towers for cooling water. The third contains useful engineering data on the design and operation of the "Radojet" air pump.

ELECTRICAL EQUIPMENT — General Electric Company, Schenectady, N. Y., has just issued the following new catalogs and bulletins: GEA-606C on "Industrial Control," covering switches, starters, controllers, resistors, etc.; GEA-602A on electrical instruments; GEA-77D on capacitors for power-factor correction; GEA-1391 on carrier-current signal equipment for unattended substations; GEA-708B on "7600 Series" synchronous motors; GEA-1435 on blast gates for low-pressure air and gas systems; GEA-1389 on "Oil-Blast" circuit breakers; GEA-938B on switchgear accessories; GEA-995B on "Arc Welding in Industry"; GEA-1429 on plastic products.

GAS BURNERS—Webster Engineering Company, Tulsa, Okla., has just completed publication of the 120-page "Webster Manual and Data Book," after two years of compilation. Containing information on gas burner design and application, it comprises a ready reference manual on gas-fired power and heating installations.

PUMPS—Information on the construction and application of water-lubricated deep-well pumps, ranging in size from 5 to 600 hp., is given in Bulletin 16A recently issued by the Pomona Pump Company, Pomona, Calif. Nearly 100 illustrations of actual installations are included.

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Fuel Prices

FUEL OIL

Boston—Sept. 1, tank-car lots, f.o.b. 12@14 deg. Baumé, 2.9c. per gal.; 28@32 deg., 4.85c. per gal.

New York—Sept. 3, f.o.b. Bayonne, N. J., 28@34 deg. Baumé, industrial use, tank-car lots, 3.75c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 4.75c. per gal.

Philadelphia—Sept. 2, No. 3, industrial gas oil, $1.83 per bbl.; No. 4, light industrial fuel oil, $1.31 per bbl.; No. 5, medium industrial fuel oil, $1.20 per bbl.; No. 6, heavy (Bunker C), $1.05 per bbl.

Pittsburgh—Aug. 19, f.o.b. local refinery, fuel oil, 30@34 deg., 2.5c. per gal.; 36@40 deg., 2.75c. per gal.

Cincinnati — Sept. 1, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 4.5c. per gal.; 26@30 deg., 4.75c. per gal.; 30@32 deg., 5c. per gal.

Chicago—Sept. 1, tank-car lots, f.o.b. Oklahoma; freight to Chicago, 90c. per bbl. or 42 gal.; 18@22 deg., 22.5c. per bbl.; 22@24 deg., 25c. per bbl.; 24@26 deg., 27.5c. per bbl.; 26@28 deg., 32.5 per bbl.; 28@30 deg., 37.5 per bbl.

St. Louis — Aug. 26, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.02 per bbl., or 42 gal.; 26@28 deg., $1.09 per bbl.; 28@30 deg., $1.17 per bbl.; 30@32 deg., $1.22 per bbl.; 32@36 deg., gas oil, 2.526c. per gal.; 38@40 deg., distillate, 3.026c. per gal.

Dallas—Aug. 29, f.o.b. local refinery 24@26 deg., 70c. per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol..	New York...	$1.60 @ $1.80
Pool 10, h. gr. low-vol.	New York...	1.50 @ 1.60
Pool 11, low-vol.....	New York...	1.35 @ 1.45
Smokeless, mine-run..	Chicago.....	1.50 @ 1.75
Smokeless, slack.....	Chicago.....	.50 @ 1.10
Harlan, Ky., slack....	Chicago.....	.75 @ 1.00
Franklin, Ill., mine-run	Chicago.....	2.15
Franklin, Ill., screen...	Chicago.....	1.10 @ 1.60
Ind. 5th Vein, m.-r....	Chicago.....	1.20 @ 1.75
Standard Ill., mine-run	St. Louis.....	1.25 @ 1.40
W. Ky., mine-run....	Louisville....	.85 @ 1.00
W. Ky., slack.....	Louisville....	.60 @ .75
Pittsburgh, mine-run.	Pittsburgh....	1.25 @ 1.45
Smokeless, mine-run..	Cincinnati...	1.60 @ 1.75
Smokeless, slack.....	Cincinnati...	.75 @ 1.10
Kanawha, mine-run..	Cincinnati...	.90 @ 1.25
Kanawha, nut-slack.	Cincinnati...	.65 @ .90
Anthracite (Net Tons)	**At Mine, for Shipment to**	**Price per Ton**
Buckwheat.....	New York...	$3.25
Barley.....	New York...	.90 @ 1.40

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., Alameda — L. Larson, Constructing Quatermaster, 33 Pacific Ave., is having plans prepared for a group of air depot buildings to include administration building, hangar, heating plant, pumping station, radio station, etc. Estimated cost $743,000. Ultimate total cost $2,700,000.

Calif., Los Angeles—City Water & Light Dept., is having specifications made for third unit of power plant No. 2 involving additional steel penstock, providing 18,000 hp. generating capacity in San Francisquito Canyon, north of Saugus, conditioning of tunnels between power plants 1 and 2, etc. Estimated cost $1,000,000. H. A. Van Norman, c/o owner is engineer.

Calif., Newport Beach—Board of Commissioners, Irvine Co., awarded contract for constructing dam 31½ ft. high to impound 12,000 to 14,000 acre ft. of water, spillway capacity 6,500 sec.ft. for caring for flood waters from El Modena to El Toro to H. W. Rohl Co., 4351 Alhambra Ave., Los Angeles. $195,000. There will be no outlet conduit from the dam, water is to be pumped from reservoir and transmitted by pipe line back into valley and used for irrigation. Will equip pipe line with booster systems.

Calif., Redwood City — Union Ice Co., 354 Pine St., San Francisco, awarded contract for a 1 story ice manufacturing plant on Brewster Ave. to Taylor & Goericke, Sharon Bldg., San Francisco. $15,000 exclusive of equipment.

Calif., San Francisco—St. Francis Ice Co., represented by C. S. Plant, 1201 California St., leased building at 10th and Bryant Sts. and plans to expend $100,000 in reconstruction of ice manufacturing plant and installation of equipment. Architect not selected.

Ill., Hartford—Village, C. W. Brown, Pres., is having preliminary plans prepared for the construction of a municipal light and power plant and distribution lines. Engineer not announced.

Ind., South Bend—Notre Dame University, will soon receive bids for addition to power plant. Estimated cost $65,000. A. Kahn Inc., 1000 Marquette Bldg., Detroit, Mich., is engineer. Equipment will be required.

Mass., Quincy — Commonwealth of Massachusetts, Metropolitan District Commission, Sewerage Division, awarded contract for the construction of pumping station, reservoir, mains, etc. to A. D. Daddario, 15 Agnes Ave., Hyde Park. $37,630.

Mass., Roxbury (sta. Boston) — House of Liederman, 169 Norfolk Ave., will build addition to boiler plant. Estimated cost $40,000. P. J. Brown, 51 Cornhill, Boston, is engineer. Work will be done by separate contracts.

Mass., Westboro—Commonwealth of Massachusetts, Dept. of Public Welfare, Boston, awarded contract for a 50 x 50 ft. addition to boiler house here to Frank Losordo Co., 24 School St., Boston. Estimated cost $25,000.

Mich., Detroit — Detroit Edison Co., 2000 Second Blvd., is having preliminary plans prepared for the construction of an 18 story office building including steam heating system, etc. on First St. Estimated cost $2,000,000. Private plans.

Minn., Detroit Lakes—City, E. J. Bestick, Clk., will soon award contract for a sanitary sewage system including motors, pumps, etc. Wolff & Coates, 903 Globe Bldg., are engineers.

Miss., Starkville—City awarded contract for the construction of a municipal electric light plant and six miles of street lighting to Fairbanks-Morse Co., 1000 St. Charles St., New Orleans, La. $101,682.

Mo., St. Louis—Bethesda Hospital, J. H. Smith, Pres., Bd. of Trustees, 3649 Vista Ave., is having plans prepared for a group of hospital buildings including nurses home, boiler house, etc. at North, South and Eager Roads. Estimated cost $1,500,000. Smith & Gauger, 514 Louderman Bldg., St. Louis, and Pond, Pond, Martin & Lloyd, 180 North Michigan Ave., Chicago, are associate architects.

Nev., Reno—Coliseum Holding Co., c/o G. E. Koster, Arcade Bldg., Archt., awarded contract for the construction of a coliseum building to house ice skating rink, etc. at West Second St. to W. K. Owen, 3145 Pleitner St., Fruitvale, Calif. $200,000.

N. H., Concord—New Hampshire State Hospital, W. A. Stone, Purch. Agt., State House, awarded contract for the construction of a 15 x 45 ft. power plant to H. E. Noyes, 60 Grove St., Claremont. Estimated total cost $40,000.

N. J., Jersey City — State Military Board, Quartermaster General Office, Trenton, will receive bids until Sept. 9, for the construction of a 4 story armory including steam heating and ventilation systems, boilers, etc. at Jordan and Summit Aves. and Montgomery St. Estimated cost $1,000,000. Osborne Hunt, Hunt Bldg., Trenton, is architect. Col. Hugh A. Kelly, 921 Bergen Ave., Jersey City, is assoc. architect.

N. Y., Mitchell Field—Constructing Quartermaster, War Dept., Washington, D. C., awarded contract for a group of buildings including headquarters and operations building, prachute building, photographic building, radio building, machine shop, paint, oil and dope house, maintenance shop, two boiler houses, etc. to J. A. Marow & Owens Co., Chicago, Ill.

N. Y., Newtown—New York & Queens Gas Co., 132-21 Roosevelt Ave., Flushing, awarded contract for a coke pocket, etc. on Flushing River here, to Nicholson Co., 405 Lexington Ave., New York, N. Y. Estimated cost $40,000.

O., Ashtabula—Ashtabula General Hospital, awarded contract for the construction of a 1 and 2 story power plant and laundry to A. J. Slaybaugh, McGovern St. Estimated cost $40,000.

O., Lakewood — City of Lakewood, E. A. Wiegand, Mayor, is having preliminary plans prepared for an 8 story hospital including steam heating, ventilation and refrigeration systems, boilers, pumps, elevators, etc. at Bunts Road and Franklin Blvd. Estimated cost $1,000,000. Hadlow, Hughes, Hick & Conrad, Citizens Bldg., Cleveland, are architects and engineers.

O., Marietta—City defeated $600,000 bonds at recent election for the construction of a municipal power plant. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, Mo., Engrs.

Pa., Pittsburgh—South Side Hospital, J. E. Roth, Pres., 6400 Beacon St., is having plans prepared for addition to hospital to include power house, etc., at South 20th and Jane Sts. Estimated cost $1,500,000. P. C. Dowler, Century Bldg., is architect.

Tex., Fort Sam Houston—A. S. Harrison, Constructing Quartermaster, will soon award contract for a group of buildings including 1 story, 447 x 560 ft. engineering shops, 66 x 260 ft. dope house, 66 x 60 ft. dope storage house, and 10 x 50 ft. boiler house, etc. Estimated cost, $440,000. Private plans.

Tex., Harlingen—City c/o S. Botts, Mayor, will soon award contract for the construction of a sewage pumping plant and sewer line. A. Tamm, 209½ West Jackson St., is engineer.

Wyo., Rawlins—Rawlins Electric Light Co., T. W. Hughes, Mgr., plans enlarging electric light and power plant. $15,000.

Equipment Wanted

Boiler—Los Angeles, Calif.—Bd. of Regents, University of California, will receive bids until Sept. 11 for a 500 hp. boiler in connection with two gymnasium buildings.

Engine—Ford City, Pa.—City is receiving bids for a 500 kw. Diesel engine for municipal light and power plant.

Generating Sets—San Francisco, Calif.—City, L. S. Leavy, Purch. Agt., will receive bids until Sept. 14, for ten electric welded motor generating sets and accessories for School Dept.

Motors and Control Equipment—New York, N. Y.—Bd. of Transportation, J. H. Delaney, Chn., 250 Hudson St., will receive bids until Sept. 25 for motors and control equipment for steel passenger cars for Independent System of city owned Rapid Transit Railways.

Pump—Long Beach, Calif.—City Council, will receive bids until Oct. 2 for a 600 g.p.m. pump in connection with North Long Beach sewer system.

Pump—Wausau, Wis.—City plans the installation of an electric pump in 60 ft. well for waterworks.

Pump and Motor—Canton, O.—City plans the installation of a 3,000,000 g.p.d. pump and motor, etc. for proposed waterworks.

Pumping Equipment—Lindsay, Ont.—City plans to purchase pumping equipment in connection with waterworks. Estimated cost $20,000.

Transformers—Everett, Wash.—Puget Sound Power & Light Co., Stuart Bldg., Seattle, plans the installation of a new unit of four 60 ton transformers, three service and one utility, 8,333 kva. each to supplement present equipment of seven transformers in Beverly Park sub-station here. Estimated cost $150,000.

Industrial Projects

Calif., Los Angeles — Stuaffer Chemical Co., Rives-Strong Bldg., will soon award contract for a 1 story, 100 x 160 ft. chemical plant on Wilmington Ave. Estimated cost $50,000.

Ill., Bellwood—Jefferson Electric Co., 15th and Laflin Sts, Chicago, awarded contract for the construction of a 1 and 2 story, 325 x 650 ft. factory here to Austin Co., 510 North Dearborn St., Chicago. Estimated cost $550,000.

N. Y., Bolivar—Alleghany Refining Co., postponed construction of oil refinery 1,000 bbl. capacity. Maturity November or later.

O., Sandusky — Ohio Colprovia Co., A. R. Lemmon, Pres., 1276 West 3rd St., Cleveland, plans the construction of a plant for the manufacture of asphaltic paving material used in resurfacing streets here. Estimated cost $125,000. Private plans.

Pa., Ambridge—Spang Chalfant & Co, Inc., Clark Bldg., Pittsburgh, awarded contract for a 1 story, 125 x 500 ft. experimental electric weld pipe mill here to American Bridge Co., Frick Bldg., Pittsburgh.

Tex., Borger—Phillips Petroleum Co., Bartlesville, Okla., plans to rebuild refinery here recently destroyed by fire. Estimated cost $75,000.

Tex., Pioneer—Concho Refinery Co., H. J. Earls, Box 745, San Angelo, will build an oil refinery here. Estimated cost $50,000. Private plans. Interested in quotations on complete laboratory equipment.

Wis., Madison—Dept. of Agriculture, Washington, D. C., awarded contract for the construction of a forest products laboratory to C. B. Fritz & Co., Madison, $727,648.

Wis., Manasha—Marathon Paper Mills Co., awarded contract for the construction of a 1 story plant and warehouse to Fluor Bros. Construction Co., 48 Otter St., Oshkosh. Estimated cost $40,000.

Wis., Manitowoc—Aluminum Specialty Co., 17th and Wallmer Sts., awarded contract for a 3 story, 45 x 60 ft. plant and warehouse on 17th St. to Kasper Construction Co., 4 North 8th St.

Wis., Menasha—Appleton Engraving Co., 348 West Water St., Appleton, is having preliminary plans prepared for a 2 story, 60 x 150 ft. engraving plant on Water St. here. Estimated cost $40,000. LeVie & Gmeiner, 601 West College Ave., Appleton, are architects.

Que., St. Lambert—J. J. Seguin Co. Ltd., plans the construction of a creosoting plant on a 65 acre site along Canadian National Railways main line to include cylinder, 8 ft. in diameter and 107 ft. in length for pressure treatment of railroad ties, bridge timber, structural timbers, construction lumber, poles and pilings. Estimated cost $200,000. Equipment includes Rueping tanks, mixing and measuring tanks, compressors for creation of vacuum, etc.

PRICES - MATERIALS - SUPPLIES

Electrical prices on following page are to the power plant by jobbers in the larger buying centers east of the Mississippi. Elsewhere the prices will be modified by increased freight charges and by local conditions.

SINCE LAST MONTH

UNSTEADINESS prevails in the current market for electrical supplies, with demand for industrial equipment and other electrical goods below that for any period in the last six years. Present quotations are substantially lower than those of a month ago, in fire hose, leather belting, rawhide lacing, cotton waste and wiping cloths. Babbitt metal, as an exception, advanced in response to a rally in non-ferrous metals. Anti-friction metal is now 28¾c. per lb., New York, compared with 28½c., in August.

POWER-PLANT SUPPLIES

HOSE—Quotations at New York warehouses:

	Fire Protection	50-Ft. Lengths
Underwriters' 2½-in., coupled, single jacket, net, per ft		$0.46½
Common, 2½-in., cotton, rubber-lined, 80c. per ft., list, less		70%

Air—Best Grade, Net

¾-in., per ft	3-ply....$0.271	4 ply....$0.337

Steam—Discounts from List

First grade.... 59% Second grade.... 60-5% Third grade.... 60-10-10%

RUBBER BELTING—List price, 6-in., 6 ply, $1.83 per lin.ft. The following discounts from New York warehouse list apply to rubber transmission belting:

Best grade....60-10-10% Second grade....70-10%

LEATHER BELTING—List price, 24c. per lin.ft., per inch of width, for single ply, at New York warehouses in quantities of about ½ doz. rolls:

First Quality	Discount from list
Medium	45%
Heavy	30-10%

RAWHIDE LACING—Prices at New York warehouse:

Lace leather sides, 15 to 17 sq.ft., net, per sq.ft	$0.45
Cut lacing, discount from list	45%

PACKING—Prices per pound at New York warehouses:

Rubber and duck for low-pressure steam, ¼ in	$0.90
Asbestos for high-pressure steam, ¼ in	1.75
Duck and rubber for piston packing	.90
Flax, regular	1.15
Flax, waterproofed	1.70
Compressed asbestos sheet	.85
Wire insertion asbestos sheet	1.20
Rubber sheet	.45
Rubber sheet, wire insertion	.75
Rubber sheet, duck insertion	.55
Asbestos packing, twisted or braided and graphited, for valve stems and stuffing boxes	1.40
Asbestos wick, ½- and 1-lb. balls	.50

PIPE AND BOILER COVERING—Discounts from list at New York warehouses are as follows:

85% magnesia, high pressure		40 %
Asbestos, air cell, for low-pressure heating and return lines	4-ply	65 %
	3-ply	67½%
	2-ply	70 %

PORTLAND CEMENT—New York, $1.85 per bbl., without including charge of 10c. each for four returnable cloth bags, delivered by truck to site of job. Packed in paper bags, 15c. above foregoing price, but no rebate as on cloth bags.

STRUCTURAL STEEL—New York delivered price, beams and channels, 3 to 15-in.; angles, 3 to 6-in., ¼-in. thick; tees, 3-in. and larger; and plates, ¼-in. thick and heavier; all $3.10 per 100 lb. in lots of 401 to 999 lb.

COTTON WASTE—The following prices are in cents per lb., at warehouse:

	New York	Cleveland	Chicago
White	6.50@9.00	13.00	13.00
Colored	5.50@8.00	9.00	9.00

WIPING CLOTHS—Prices per pound in lots of about six bales (600 lb.), for colored wipers, as follows:

New York	$0.10
Cleveland	.08
Chicago	.09

LINSEED OIL—These prices are for raw oil in barrels, f.o.b., in 1 to 4 bbl. lots:

	New York	Minneapolis	Chicago
Per pound	$0.087	$0.098	$0.098

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b., New York:

	Dry	In Oil
Red	$13.25	$14.75
White	13.25	13.25

RIVETS—The following quotations apply on fair-sized orders from warehouse:

Tank rivets, ⅞-in. diameter and smaller, list less 65% in full packages, for immediate delivery from warehouse stocks in New York and vicinity.

Structural rivets, ½-in., round head, full kegs, per 100 lb.:

New York	$4.00
Chicago	4.00
Pittsburgh mill	2.75

Broken kegs, about 50c. higher.

REFRACTORIES—Prices in car-loads, f.o.b. plant:

Chrome brick, eastern shipping points	per net ton	$45.00
Chrome ore, ground, 40@50%, Cr_2O_3, in bulk	per net ton	22@25
Chrome ore, ground, 40@50%, Cr_2O_3, in sacks	per net ton	26@29
Chrome ore, crude, 40@50%, Cr_2O_3	per net ton	20.00@22.50
Magnesite brick, 9-in. straights	per net ton	65.00
Magnesite brick, 9-in. arches, wedges and keys	per net ton	71.50
Magnesite brick, soaps and splits	per net ton	91.00
Silica brick, Mt. Union, Pa	per M	40.00
Clay brick, 1st quality, 9-in. shapes, Pennsylvania	per M	40@43
Clay brick, 1st quality, 9 in. shapes, Ohio	per M	40@43
Clay brick, 1st quality, 9 in. shapes, Kentucky	per M	40@43
Clay brick, 1st quality, 9 in. shapes, Maryland	per M	40@43
Clay brick, 2nd quality, 9 in. shapes, Pennsylvania	per M	35@38
Clay brick, 2nd quality, 9 in. shapes, Ohio	per M	32@35
Clay brick, 2nd quality, 9 in. shapes, Kentucky	per M	32@35
Clay brick, 2nd quality, 9 in. shapes, Maryland	per M	32@35

BABBITT METAL—Delivered in case-lots from New York warehouse, on orders of 100 lb. or over, cents per pound:

Genuine, highest grade	44.25
Commercial, intermediate grade	34.50
Anti-friction metal, general service	28.75
Solder, bar	19.62½

COLD-FINISHED STEEL—Warehouse prices on shafting and screw stock, per 100 lb., base, are as follows:

	New York	Cleveland	Chicago
Round or hexagon	$3.40	$3.10	$3.10
Flat or square	3.90	3.60	3.60

BOILER FITTINGS—Discounts from list at New York warehouse:

Copper ferrules	70%
Flanges	50%
Stay bolts	60%
Patch bolts	20%
Fitting-up bolts	45%
Pressed steel boiler lugs	10%

WROUGHT PIPE—The following basing discounts from list, are for large mill-lots at Pittsburgh mill:

BUTT WELD

	Steel Black	Steel Galv.		Iron Black	Iron Galv.
Inches			Inches		
1 to 3	64%	52½%	1 and 1¼	31%	15%

LAP WELD

2	57%	45½%	2	23%	9%
2½ to 6	61%	49½%	2½ to 3½	28%	13%
7 and 8	58%	45½%	4 to 6	30%	17%
9 and 10	56%	43½%	7 and 8	29%	16%
11 and 12	55%	42½%	9 to 12	26%	11%

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	62%	51½%	1 to 2	34%	18%
2 to 3	63%	52½%			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	55%	44½%	2	29%	13%
2½ to 4	59%	48½%	2½ to 4	34%	20%
4½ to 6	58%	47½%	4½ to 6	33%	19%
7 and 8	54%	41½%	7 and 8	31%	17%
9 and 10	47%	34½%	9 to 12	21%	8%
11 and 12	46%	33½%			

BOILER TUBES—Standard gage, manufactured in accordance with the specifications and requirements of the American Society of Mechanical Engineers and in compliance with the rules and regulations of the U. S. Steamboat Inspection Service, from New York warehouse stock, per 100 ft.:

Size, Inches*	B.W.G.	Toncan Seamless Iron	Knobbled Charcoal Iron	Seamless Steel	Lapwelded Steel
1	13	$34.00	.....	$18.00	.....
1¼	13	37.75	.....	20.25	.....
1½	13	38.00	$38.00	19.25	.....
1¾	13	30.00	30.00	22.00	.....
2	13	26.25	26.25	20.25	$19.00
2¼	13	34.50	34.50	23.00	25.00
2½	12	34.00	34.00	26.00	24.25
2¾	12	40.50	40.50	28.50	27.50
3	12	42.50	42.50	27.00	25.50
3¼	11	50.25	50.25	30.75	28.75
3½	11	54.50	54.50	33.25	31.50
4	10	67.00	67.00	40.00	38.00

These prices are based on stock lengths. If cut to special lengths, billing will be based on the entire stock lengths. In addition to the foregoing, standard cutting charges are as follows:

2-in. and smaller..$0.05 per cut
2¼ and 2½ in..... .06 per cut
3-in..... $0.09 per cut
3¼ to 4 in..... .10 per cut

*External diameter.

ELECTRICAL SUPPLIES

ARMORED CABLE—Price per 1,000 ft., New-Style, A.B.C., with fibre bushing:

B. & S. Size	BX Two Cond. M. Ft.	BX Three Cond. M. Ft.	Lead Two Cond. M. Ft.	Lead Three Cond. M. Ft.
No. 14 solid....	$23.50	$33.00	$55.00	$75.00
No. 12 solid....	33.00	44.00	66.00	91.00
No. 10 solid....	45.00	57.00	82.00	105.00
No. 8 stranded..	73.00	92.00	115.00	155.00
No. 6 stranded..	105.00	129.00	155.00	220.00

Coils to 1000 ft., +10%; less than coil lots, +20%.

CONDUIT—Rigid iron, price per 1,000 ft.; **ELBOWS AND COUPLINGS**, per 100 pieces, extra. Delivered from New York warehouse. Discount of 5 per cent for payment in 10 days; 30 days net:

Size, Inches	GALVANIZED Conduit	GALVANIZED Couplings	GALVANIZED Elbows	BLACK Conduit	BLACK Couplings	BLACK Elbows
¼	$52.15	$3.15	$7.55	$47.31	$2.86	$6.47
⅜	52.75	3.78	7.60	47.91	3.44	6.52
½	53.93	4.42	7.72	49.09	4.02	6.64
¾	68.61	6.34	10.17	62.05	5.78	8.75
1	98.17	8.28	15.19	88.49	7.54	13.09
1¼	132.83	11.67	20.88	119.72	10.71	18.33
1½	158.82	14.46	27.94	143.14	13.26	24.52
2	213.68	19.35	50.82	192.60	17.77	44.55
2½	337.85	27.65	84.15	304.50	25.37	73.89
3	441.80	41.44	216.97	398.19	38.02	189.61
3½	557.58	55.61	474.82	505.14	51.05	414.40
4	681.33	69.30	549.07	619.19	63.60	479.25
4½	793.78	103.32	827.42	721.41	94.76	721.70
5	925.10	114.02	1150.87	840.74	104.61	1004.11
6	1200.61	164.80	1435.97	1090.67	151.12	1253.57

CONDUIT BODIES AND FITTINGS—Black or galvanized:

	Less Than $15 List	$15 List to $100	$100 List and Over
Standard package	15%	20%	28%
Less than standard package	10%	15%	20%

CUT-OUTS—Following are net prices, each, in standard-package quantities:

CUT-OUTS, PLUG, SOLID, NEUTRAL OR 2-FUSE

S. P. M. L.	$0.12	D. P. D. B.	$0.31
D. P. M. L.	.16	T. P. S. B.	.35
T. P. M. L.	.27	T. P. D. B.	.47
D. P. S. B.	.16		

CUT-OUTS, N. E. C. FUSE, SOLID, NEUTRAL OR 2-FUSE

	0-30 Amp.	31-60 Amp.	60-100 Amp.
D. P. M. L.	$0.27	$0.70	$1.75
T. P. M. L.	.40	1.00	2.30
D. P. S. B.	.35	.87	.....
T. P. S. B.	.67	1.50	.....
D. P. D. B.	.65	1.75	.....
T. P. D. B.	1.12	3.00	.....
T. P. to D. P. D. B.	.75	2.10	.....

FLEXIBLE CORD—Price per 1,000 ft. in coils of 250 ft.:

No. 18 cotton reinforced heavy		$14.00
No. 16 cotton reinforced heavy		17.50
No. 18 cotton reinforced light		11.50
No. 16 cotton reinforced light		14.00
No. 18 cotton Canvasite cord		12.50
No. 16 cotton Canvasite cord		13.60
No. 16 super service cord or similar (2 wire) in 1,000 ft.	$54.00	*59.00
No. 14 super service cord or similar (2 wire) in 1,000 ft.	82.00	*89.50

*Less than 1,000 ft.

NATIONAL ELECTRIC CODE FUSES, NON-REFILLABLE—

250-Volt	Std. Pkg.	List Each	600-Volt	Std. Pkg.	List Each
3-amp. to 30-amp.,	100	$0.15	3-amp. to 30-amp.,	100	$0.30
35-amp. to 60-amp.,	100	.30	35-amp. to 60-amp.,	100	.60
61-amp. to 100-amp.,	50	.90	65-amp. to 100-amp.,	50	1.50
101-amp. to 200-amp.,	25	2.00	110-amp. to 200-amp.,	25	2.50
201-amp. to 400-amp.,	25	3.60	225-amp. to 400-amp.,	25	5.50
401-amp. to 600-amp.,	10	5.50	450-amp. to 600-amp.,	10	8.00

Discount: Less than one-fifth standard package, 60%; one-fifth to standard package, 65%; standard package, 70%.

RENEWABLE FUSES—List price each:

Sizes	250-Volt List-Price	600-Volt List-Price	Std. Pkg. Quantity	Carton Quantity
1 to 30-amp.....	$0.50	$1.10	100	10
35 to 60-amp.....	1.00	1.25	100	10
65 to 100-amp.....	2.00	3.00	50	5
110 to 200-amp.....	4.00	5.00	25	5
225 to 400-amp.....	7.50	11.00	25	1
450 to 600-amp.....	11.00	16.00	10	1

REFILLS—

1 to 30-amp.....	$0.03 ea.	$0.05	100	100
35 to 60-amp.....	.05 ea.	.06	100	100
65 to 100-amp.....	.10 ea.	.10	50	50
110 to 200-amp.....	.15 ea.	.15	25	50
225 to 400-amp.....	.30 ea.	.30	25	25
450 to 600-amp.....	.60 ea.	.60	10	10

Discount Without Contract—Fuses:
Broken cartons..... Net list
Unbroken cartons..... 17%
Ten unbroken cartons..... 34%

Discount Without Contract—Renewals:
Broken cartons..... Net list
Unbroken cartons..... 17%
Ten unbroken cartons..... 34%

Discount With Contract—Fuses:
Broken cartons..... 5%
Unbroken cartons..... 20%
Ten unbroken cartons..... 36%

Discount With Contract—Renewals:
Broken cartons..... Net list
Ten unbroken cartons..... 36%

Carton quantities may be combined to obtain maximum discounts.

FUSE PLUGS, MICA CAP—

0–30 ampere, standard package (500), per 100	$2.50
0–30 ampere, less than standard package, per 100	2.75

LAMPS—Below are present quotations in less than standard package quantities on Mazda standard, A type bulbs:

100—130 Volt Watts	General Type	Price Each	200—260 Volt Watts	Special Type	Price Each
15	A 17	$0.20	25	A 19	$0.25
25	A 19	.20	50	A 21	.25
40	A 21	.20	100	A 23	.45
50	A 21	.20	...	....	.....
60	A 21	.20	...	....	.....
100	A 23	.35	...	....	.....

Carton quantities are subject to discount of 10% from list. Annual contracts ranging from $75 to $300,000 net, allow a discount of 15 to 40% from list.

PLUGS, ATTACHMENT—

	Each
Porcelain, separable, attachment plug	$0.18
Composition, 2-piece, attachment plug	.27
Swivel attachment plug	.12
Small size, 2-piece plug, composition	.05

RUBBER-COVERED COPPER WIRE—Per 1000 ft. f.o.b. New York:

No.	Solid Single Braid	Solid Double Braid	Stranded, Double Braid	Solid Duplex
14	$4.40	$6.40	$7.40	$12.60
12	6.40	7.75	9.20	16.00
10	8.50	10.20	11.70	21.00
8	12.20	14.30	16.75	29.00
6	.....	.....	24.60	.....
4	.....	.....	33.40	.....
2	.....	.....	46.00	.....
1	.....	.....	66.00	.....
0	.....	.....	78.00	.....
00	.....	.....	91.00	.....
000	.....	.....	106.00	.....
0000	.....	.....	131.00	.....

SOCKETS, BRASS SHELL—Price each, net:

	½ In. or Pendant Cap Key	½ In. or Pendant Cap Keyless	½ In. or Pendant Cap Pull	¾ In. Cap Key	¾ In. Cap Keyless	¾ In. Cap Pull
Standard package	$0.12	$0.10	$0.16	$0.16½	$0.14	$0.20
Unbroken carton	.14	.12	.18	.18	.16	.21
Broken carton	.16	.14	.20	.20	.18	.24

WIRING SUPPLIES—

Friction tape, ¾ in., in less than 100 lb., 25c. per lb.; in 100 lb. lots, 24c. per lb
Rubber tape, ¾ in., in less than 100 lb., 26c. per lb.; in 100 lb. lots, 24c. per lb.
Wire solder, in less than 100 lb., 24c. per lb.; in 100 lb. lots, 20c. per lb.
Soldering paste, 2 oz. cans..... $1.10 doz.

ENCLOSED SWITCHES, KNIFE—Safety type, externally operated, 250 d.c. or a.c., N.E.C.:

TYPE "C" FUSED BOTTOM

Size, Amp.	Double Pole, Each	Three Pole, Each	Four Pole Each
30	$3.50	$5.70	$9.00
60	9.00	11.00	14.00
100	14.00	17.00	29.00
200	22.00	29.00	48.00

Discounts:
Standard package..... 50%
Less than standard package..... 45%